Alternative Fuel Vehicle Refueling Stations Financing Program Design

April 30, 2015

Prepared For:

Maryland Energy Administration
60 West Street, Suite 300
Annapolis, MD 21401

Prepared By:

New West Technologies, LLC
8201 Corporate Drive, #800
Landover, MD 20785

Table of Contents

Introduction

The Maryland Energy Administration (MEA) is an agency of the State of Maryland and is authorized by State law to maximize energy efficiency, increase the use of renewable and clean energy sources, and improve the environment. MEA is also engaged in the broader issues of sustainability, climate change and alternative transportation fuels and technologies.

To build on its existing financing programs and to offer financing support to entities that wish to install alternative fuel vehicle (AFV) refueling infrastructure, MEA contracted with New West Technologies, LLC (New West) to conduct an analysis of the existing financial barriers to establishing alternative fuel vehicle (AFV) refueling infrastructure in Maryland, and to develop recommendations for financial mechanisms and programs for overcoming these barriers in the future. The results of the study will be the basis of a pilot program for the State for addressing financial barriers to AFV refueling infrastructure. In completing this contract effort, New West conducted research and analysis in three separate task areas: 1.) Evaluation of AFV Refueling Infrastructure in Maryland; 2.) Identification of Financial Barriers to Wider Implementation of AFV Refueling Infrastructure in Maryland; and 3.) Development of a Maryland Pilot Financing Program for Addressing Barriers to AFV Refueling Infrastructure. Individual task reports were developed for each of these activities. This report summarizes the results of these individual task efforts.

Evaluation of AFV Refueling Infrastructure in Maryland

Current Status of AFV Refueling Infrastructure in Maryland

The first objective was to evaluate the current state of non-residential AFV refueling infrastructure in the State of Maryland. The alternative fuels considered for this exercise were compressed natural gas (CNG), ethanol (E85), electricity, and liquefied petroleum gas (LPG). A number of literature and online sources were utilized for compiling this information, including the U.S. Department of Energy's Clean Cities Alternative Fuels Data Center online database[1] and the Powered by CNG website's list of Maryland CNG Stations[2]. The locations of both public- and private-access stations were included in the research. A graphical depiction of the results of this research is shown in Figure 1, illustrating the existing network of AFV refueling stations by fuel type. The figure also breaks down the State into the following five regions from west to east: **Western**, **Capital**, **Central**, **Southern**, and **Eastern Shore**.

A summary of the numbers of existing AFV refueling stations is provided in Table 1. Note that the majority of the public stations are currently located in the Capital and Central regions. This is to be expected when correlating these locations with State population centers. The largest numbers of existing public access stations in Maryland are EV charging stations. A complete listing of existing AFV station locations and owner contact information is provided in Appendix A of this report.

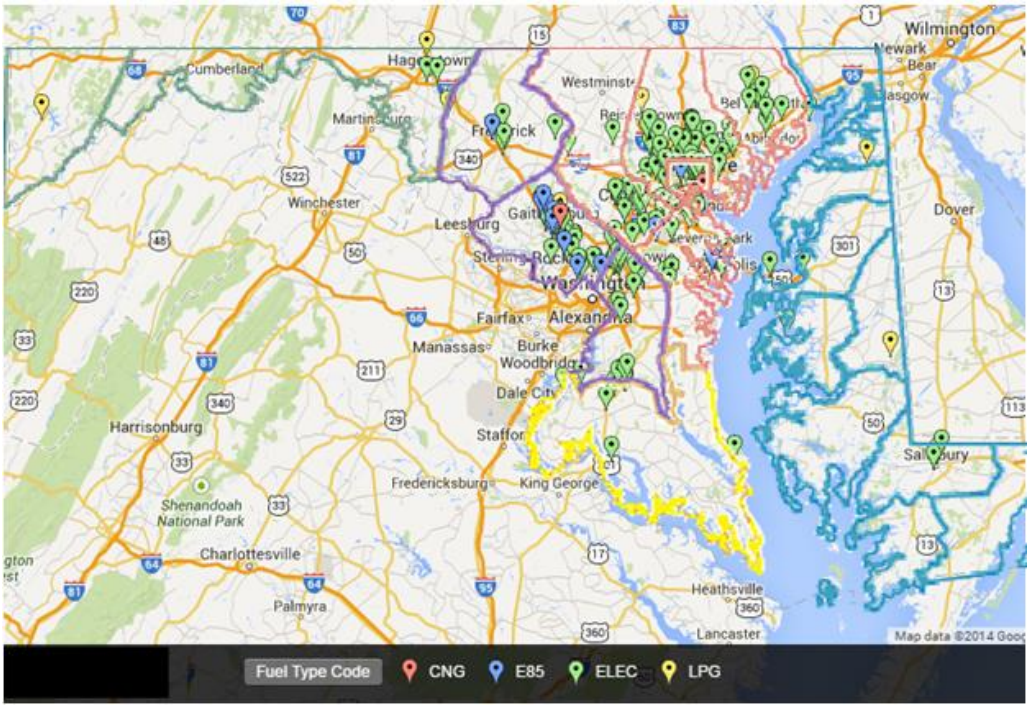

Figure 1. MD Map of Public AFV Refueling Infrastructure

Table 1. Summary of Existing AFV Refueling Stations in Maryland

AFV Refueling Station Type	Total Private Access Stations	Public Access Stations					
		Western MD	Capital MD	Central MD	Southern MD	Eastern Shore MD	Total
CNG	7	0	1	2	0	0	10
E85	0	0	11	4	0	0	15
Electricity	0	2	55	137	13	6	213
LPG	0	2	4	7	1	3	17
Totals	7	4	71	150	14	9	255

AFV Refueling Station Owner Survey

In order to document specific information concerning the existing Maryland-based AFV refueling station network in terms of operation, costs, permitting, funding, and station attributes, individual owners of Maryland AFV refueling stations were contacted. To facilitate the collection of this information, a survey instrument was developed and used in contacting the existing station owners to ensure a consistent and comprehensive database. Topical areas covered in the survey included the following:

- Station ownership
- Station installation costs and financial assistance
- Barriers to implementation and operation
- Station pump price breakdown
- Operation costs and customer payments
- Station utilization characteristics

A copy of the survey instrument is provided in Appendix B for reference.

The station contact list shown in Appendix A served as the basis for conducting the survey. A sample population of 46 station owners and associated organizations was selected for conducting the survey representing all four alternative fuel types and broad geographical coverage within the state. For the 46 contacted, a 35% response rate was achieved in terms of yielding valuable data. Appendix C provides a summarized listing of the sample population making up the survey and identification of those organizations that responded with information. Table 2 lists a breakdown of survey respondents by fuel type.

Table 2. Summary of AFV Station Survey Respondents

AFV Refueling Station Type	Private Access Station Respondents	Public Access Station Respondents	Associated Fuel Industry Respondents	Totals
CNG	1	0	0	1
E85	0	1	3	4
Electricity	0	3	2	5
LPG	0	3	3	6
Total	1	7	8	16

Highlights of the information and data obtained from the survey have been summarized below by alternative fuel type. It should be noted that the information summarized below is not represented in this report as necessarily being accurate, but simply reflects the perceptions, comments, and data of the survey respondents.

CNG Vehicle Refueling Infrastructure

- Only one public access CNG station provided information.
- The CNG station did not receive any financing assistance, but was funded internally.
- If grants would have been available at the time of initial capital investment, management would have pursued these.
- The manager of the station viewed local permitting as a large obstacle in the process of building a new site.
- A gasoline gallon equivalent at the publically accessible station will be $1.50 when it is made available, with about 25 cents included for capital recovery.
- The estimated throughput of the station is 33,000 gasoline gallon equivalent (GGE) per month.
- Once the new public station is built, an average of 1,000 CNG vehicles is expected to visit per month.
- The CNG Station will likely serve primarily medium to heavy duty vehicles.
- The manager said that a 3-5 year return of investment would be reasonable for the public station.

- The manager liked the idea of a loan that is tied into property tax so that if the station changed hands the new owner would be responsible for the loan.
- The equipment cost for this station, two fast fill dispensers and a 3,600 psi compressor, was about $1,000,000.
- The installation cost was $204,000.
- The permitting of the station cost $18,800.
- The manager figured that monthly operation and maintenance was about $8,000.

E85 Vehicle Refueling Infrastructure

- The E85 stations that were interviewed were privately owned.
- The stations received grants to assist in the building of their stations.
- The station owners were interested in low interest loans and financing through banks.
- The biggest barrier perceived while building the station was finding a contractor knowledgeable enough in E-85 station construction.
- Customers can pay with any payment method.
- $3.49 per gallon is the average current pump price of E-85. No percentage was given for capital recovery or operation and maintenance.
- One station stated they went through 1,000 gallons a month and that 2-3 cars per day refill on E-85 at their station.
- One station added that the majority of their E-85 customers are government owned vehicles, and that there is still a need for education on the use of E-85 for properly-equipped (flexible fuel) vehicles.
- One station owner liked to see six years as the time to receive return on investment.
- A station owner added that E-85 doesn't sell as well as gasoline, and it is not as readily available.
- E-85 stations are usually not independent stations and also have gasoline available at the pump; these combined stations cost around $15,000 to purchase.
- Installation contractors usually take care of permitting, and it is usually about $1,000.
- The most significant cost during installation is the E-85 compatible underground storage tank (6,000 gallon) which costs about $15,000
- The total equipment cost of an E-85 station with a tank costs $30,000.
- A station owner added that a good Maryland-based source of E-85 fuel would be very helpful as supply is low in Maryland. This would also help cut down on transportation costs from out of state suppliers.

Electric Vehicle Charging Infrastructure

- Plug-in electric vehicle (PEV) charging infrastructure is very cheap when compared to other alternative fueling infrastructure.

- All stations that were interviewed were privately owned.
- Due to the low cost of the charging infrastructure the owners of pay stations generally purchase them out-right and do not receive grants or loans for their charging stations.
- No large barriers were perceived for the charging stations. The most significant barrier identified was that electricians need to be certified to install the charge stations.
- Electric charging stations can either be pay stations or free stations.
  - Pay stations accept credit cards, a PayPal account, or have driver accounts that track the usage and how much money they owe.
  - Car dealerships offer free charging at their facilities due to the fact that they sell PEV vehicles.
  - Owners of pay stations are allowed to set the pricing of their electricity by kilowatt-hour or by time the vehicle is stopped.
- Due to the fact that some stations are still free, they do not track, nor can confirm, the monthly kilowatt-hour usage of their stations.
- One station stated that they provide service for anywhere from 30 to 50 electric vehicles in a month, some stopping by once a night.
- No owners of pay stations could be reached to determine how quickly they would like to see the return of investment on their charging station.
- The majority of charging stations in the State are Level 2 chargers.
- The main cost of a level 2 charging station is that of the equipment and installation:
  - Installation cost estimates ranged $ 2,000 to $3,000 per station.
  - Equipment costs ranged from $4,000 to slightly over $7,000.
  - Maintenance and permitting requires no significant cost, if any.

Liquid Propane Gas Vehicle Refueling Infrastructure

- Most LPG stations in the State are not set up specifically for autogas propane, but have the capability to fuel vehicles because the existing infrastructure is capable of fueling vehicles.
- The existing stations were purchased outright by the propane companies.
- Customers can pay via cash or credit card.
- Prices taken during the survey ranged from $3.45 – 4.29 per gallon
- Respondents did not offer estimates of the percentage of the fuel price factored in for capitol recovery, or operation and maintenance.
- Due to the fact that existing stations do not generally serve propane vehicles, no monthly fuel or vehicle throughput figures could be obtained.
- One station owner stated that a five year return of investment would justify having a station built.
- Equipment costs for a propane station are around $20,000.

- Installation cost was estimated around $5,000.
- Permitting for the station was estimated at about $200.
- Monthly operation and maintenance was estimated around $3,000.

Assessment of Existing Refueling Station Capacity for Future AFV Populations

Based on the existing AFV refueling station network in Maryland, an assessment of its capacity for serving future populations of AFVs, as defined by State of Maryland policy goals, was made. In researching current Maryland policy goals for AFV implementation, only the EV goal of 60,000 vehicles in the State by year 2020 as established by the Electric Vehicle Infrastructure Council was identified. As a result, for purposes of this report, and to serve as a consistent basis of comparison among the primary alternative fuel types in the State, the same 60,000 future vehicle goal was selected for the CNG, E85, and LPG vehicle cases, respectively. As a point of comparison with these future AFV population goals, Table 3 lists the reported number of AFVs in the State in 2013 according to the MEA.

Table 3. Reported Number of AFVs by Type in Maryland in 2013

AFV Type	Number of AFVs in Maryland in 2013
CNG	14,554
Flex-Fuel(E85)	291,721
Electric	2,793
LPG	0

As a simplifying means of geographically distributing the future AFV populations, it was decided to distribute AFV numbers across the State according to recent population figures. Vehicle inventory correlation with human population has been proven in the past, and is therefore likely to exhibit an equally strong correlation in the future. Table 4 lists the distribution of future AFV populations according to the 2020 forecasted county populations[3] in the State and the previously-defined five State regions.

A recent study[4] prepared for the Maryland Electric Vehicle Infrastructure Council assessed the required number of electric vehicle chargers in Maryland for supporting 60,000 electric vehicles, so these estimates were also used for purposes of this section. Table 5 illustrates the number of existing electric vehicle chargers by type and county as well as the total required number chargers for meeting the 60,000 vehicle goal. Table 6 shows the resulting incremental number of new electric vehicle chargers required by county for supporting the 60,000 vehicle goal.

Table 4. AFV Populations in Each County for 60,000 AFVs

Maryland Region	Maryland County	2020 Percentage of Population	60,000 AFVs
Western	Allegany County	1.2%	713
	Garrett County	0.5%	299
	Washington County	2.7%	1,618
Capital	Frederick County	4.5%	2,725
	Montgomery County	17.0%	10,175
	Prince George's County	14.5%	8,726
Central	Carroll County	3.1%	1,868
	Harford County	4.4%	2,617
	Baltimore County	13.3%	7,975
	Baltimore City	10.5%	6,309
	Howard County	4.9%	2,962
	Anne Arundel County	8.8%	5,263
Southern	Calvert County	1.6%	9,51
	Charles County	2.8%	1,677
	St. Mary's County	2.1%	1,231
Eastern Shore	Caroline County	0.6%	381
	Cecil County	2.1%	1,234
	Dorchester County	0.6%	344
	Kent County	0.4%	210
	Queen Anne's County	0.9%	527
	Somerset County	0.4%	268
	Talbot County	0.6%	379
	Wicomico County	1.7%	1,017
	Worcester County	0.9%	532

Table 5. Total Public/Workplace Chargers Required for 60,000 PEVs by Type and Region[4]

Maryland Region	Maryland County	Existing			Required New		
		PEV L1 Chargers	PEV L2 Chargers	PEV L3 Chargers	PEV L1 Chargers	PEV L2 Chargers	PEV L3 Chargers
Western	Allegany County	0	0	0	327	126	1
	Garrett County	0	0	0	137	53	1
	Washington County	0	1	6	743	286	3
Capital	Frederick County	0	7	0	1,251	481	5
	Montgomery County	8	53	4	4,673	1,796	20
	Prince George's County	29	77	1	4,007	1,540	17
Central	Carroll County	0	4	0	858	330	4
	Harford County	0	14	0	1,202	462	5
	Baltimore County	34	55	1	3,662	1,407	16
	Baltimore City	36	125	0	2,897	1,113	13
	Howard County	10	41	0	1,360	523	6
	Anne Arundel County	6	25	1	2,417	929	11
Southern	Calvert County	0	1	0	437	168	2
	Charles County	6	14	1	770	296	3
	St. Mary's County	0	0	0	565	217	2
Eastern Shore	Caroline County	0	0	0	175	67	1
	Cecil County	0	0	0	567	218	2
	Dorchester County	0	0	0	158	61	1
	Kent County	0	0	0	96	37	0
	Queen Anne's County	1	3	1	242	93	1
	Somerset County	0	0	0	123	47	1
	Talbot County	0	2	0	174	67	1
	Wicomico County	0	5	0	467	179	2
	Worcester County	0	0	0	244	94	1
	Totals	130	427	15	27,554	10,589	120

Table 6. Total Number of New Public/Workplace Chargers for 60,000 PEVs By Type and Region

Maryland Region	Maryland County	Total New Chargers Required		
		PEV L1 Chargers	PEV L2 Chargers	PEV L3 Chargers
Western	Allegany County	327	126	1
	Garrett County	137	53	1
	Washington County	743	285	0
Capital	Frederick County	1,251	474	5
	Montgomery County	4,665	1,743	16
	Prince George's County	3,978	1,463	16
Central	Carroll County	858	326	4
	Harford County	1,202	448	5
	Baltimore County	3,628	1,352	15
	Baltimore City	2,861	988	13
	Howard County	1,350	482	6
	Anne Arundel County	2,411	904	10
Southern	Calvert County	437	167	2
	Charles County	764	282	0
	St. Mary's County	565	217	2
Eastern Shore	Caroline County	175	67	1
	Cecil County	567	218	2
	Dorchester County	158	61	1
	Kent County	96	37	0
	Queen Anne's County	241	90	0
	Somerset County	123	47	1
	Talbot County	174	65	1
	Wicomico County	467	174	2
	Worcester County	244	94	1
	Totals	27,424	10,162	105

To make an assessment of the total numbers of public access refueling stations necessary to support the future 60,000 vehicle population goals for the remaining fuels CNG, E85 and LPG, a methodology was utilized from a Center for Automotive Research source[5]. The equation utilized was as follows:

Number of Refueling Stations = ((AVMT)(Number of AFVs)/(MPGe))/(AFVS)*

Where: AVMT = Average Annual Vehicle Miles Travelled
MPGe = Miles per gasoline gallon equivalent
AFVS = Average Annual Station Throughput

While Table 3 indicates that the number of E85 vehicles in the State has already surpassed 291,000 vehicles in 2013, it should be remembered that these vehicles are flexible-fuel capable and can operate on gasoline, E85, or any mixture of the two. To date, these vehicles are operating primarily on gasoline, as supported by the MEA's estimate of E85 fuel consumed in Maryland in 2013 of only 622,637 gallons. This equates to only about 2 gallons of E85 consumed per flexible-fuel vehicle. Therefore, for purposes of determining future AFV refueling station capacity needs in this task, it was assumed that the future AFVs would be refueling primarily on the alternative fuel, as would be experienced in a mature alternative fuel market.

Table 7 lists the assumptions for AFV and refueling station operations used in this analysis. It was assumed that the future E85 and electric vehicle populations would be light duty vehicles, while those for CNG and LPG would be a 50/50 mix of light and medium/heavy duty vehicles. The average fuel economy and annual miles traveled were obtained using the Oak Ridge National Labs Transportation Energy Data Book[6]. The average annual station throughput values shown for CNG, LPG and E85 in Table 7 were assumed to be 10% of the current national average gasoline station annual throughput reported by the NACS[7]. This 10% value assumes a minimum amount of alternative fuel throughput for acceptable capital payback by the station owner, and compares well with current public access alternative fuel station throughputs relative to gasoline volumes. It further assumes that the refueling equipment for these three alternative fuels will continue to be additive elements to existing gasoline refueling stations rather than stand-alone stations in the future.

Using the above-mentioned methodology and assumptions, the total numbers of required public access AFV refueling stations for serving the 60,000 AFV goals were estimated by county for CNG, E85, and LPG. Table 8 lists the total required stations in comparison with the existing numbers. Table 9 shows the incremental required new stations for CNG, E85, and LPG in the five State regions.

Table 10 provides a summary of the estimated number of required new public/workplace recharging/refueling station required for supporting the 60,000 vehicle goal for each of the four alternative fuel types. As expected, the largest majority of stations required are in the Capital and Central regions of the State. It should be restated that these required station estimates assume that the 60,000 AFVs that they support refuel primarily on the alternative fuel, as would be experienced in mature alternative fuel markets.

For completeness, an estimate of the number of E85 refueling stations was derived for accommodating the current number of flexible fuel vehicles (reported to be over 291,000 in 2013) in the State assuming they refuel only on E85. Using the same methodology explained above, Table 11 shows that a total number of 783 E85 public stations would be required for supporting the State's current flexible fuel vehicle population using only E85 fuel.

Table 7. Assumptions for AFV and Refueling Operations

Public Access Refueling Station Type	Station Vehicle Mix	Average Fuel Economy (MPGe)	Average Annual Miles Traveled per Vehicle	Station Throughput
CNG	CNG LDV	24.9	12,000	157,989 GGE
	CNG MDV/HDV	7.3	13,000	
LPG	LPG LDV	24.9	12,000	157,989 GGE
	LPG MDV/HDV	7.3	13,000	
E85	E85 LDV	24.9	12,000	157,989 GGE

Table 8. Total AFV Stations Required by County for 60,000 AFVs for CNG, E85 and LPG Cases

Maryland Region	Maryland County	Existing Public Stations			Required New Public Stations		
		CNG Stations	E-85 Stations	LPG Stations	CNG Stations	E-85 Stations	LPG Stations
Western	Allegany County	0	0	0	5	2	5
	Garrett County	0	0	0	2	1	2
	Washington County	0	0	2	12	5	12
Capital	Frederick County	0	1	0	20	8	20
	Montgomery County	1	9	2	73	31	73
	Prince George's County	0	1	2	63	27	63
Central	Carroll County	0	0	0	13	6	13
	Harford County	0	0	1	19	8	19
	Baltimore County	0	0	2	57	24	57
	Baltimore City	2	1	2	45	19	45
	Howard County	0	0	0	21	9	21
	Anne Arundel County	0	3	2	38	16	38
Southern	Calvert County	0	0	0	7	3	7
	Charles County	0	0	1	12	5	12
	St. Mary's County	0	0	0	9	4	9
Eastern Shore	Caroline County	0	0	1	3	1	3
	Cecil County	0	0	0	9	4	9
	Dorchester County	0	0	0	2	1	2
	Kent County	0	0	1	2	1	2
	Queen Anne's County	0	0	0	4	2	4
	Somerset County	0	0	0	2	1	2
	Talbot County	0	0	0	3	1	3
	Wicomico County	0	0	1	7	3	7
	Worcester County	0	0	0	4	2	4
	Totals	3	15	17	430	183	430

Table 9. Total Number of New Public AFV Stations Required for 60,000 AFVs by Region for CNG, E85 and LPG Cases

Maryland Region	Maryland County	Total New Stations Required Public Stations		
		CNG Stations	E-85 Stations	LPG Stations
Western	Allegany County	5	2	5
	Garrett County	2	1	2
	Washington County	12	5	10
Capital	Frederick County	20	7	20
	Montgomery County	72	22	71
	Prince George's County	63	26	61
Central	Carroll County	13	6	13
	Harford County	19	8	18
	Baltimore County	57	24	55
	Baltimore City	43	18	43
	Howard County	21	9	21
	Anne Arundel County	38	13	36
Southern	Calvert County	7	3	7
	Charles County	12	5	11
	St. Mary's County	9	4	9
Eastern Shore	Caroline County	3	1	2
	Cecil County	9	4	9
	Dorchester County	2	1	2
	Kent County	2	1	1
	Queen Anne's County	4	2	4
	Somerset County	2	1	2
	Talbot County	3	1	3
	Wicomico County	7	3	6
	Worcester County	4	2	4
	Totals	427	168	413

Table 10. Summary of Required New Public/Workplace Recharging/Refueling Stations for Future 60,000 AFV Goals

PEV Chargers			CNG	E85	LPG
Level 1	Level 2	Level 3			
27,424	10,162	110	427	168	413
37,696					

Table 11. Number of Required E85 Stations for Supporting Number of Flexible-Fuel Vehicles in Year 2013

Maryland Region	Maryland County	E85 Existing Stations	E85 Stations required	New E85 Stations Required
Western	Allegany County	0	9	9
	Garrett County	0	4	4
	Washington County	0	22	22
Capital	Frederick County	1	36	35
	Montgomery County	9	135	126
	Prince George's County	1	116	115
Central	Carroll County	0	25	25
	Harford County	0	35	35
	Baltimore County	0	106	106
	Baltimore City	1	84	83
	Howard County	0	39	39
	Anne Arundel County	3	70	67
Southern	Calvert County	0	13	13
	Charles County	0	22	22
	St. Mary's County	0	16	16
Eastern shore	Caroline County	0	5	5
	Cecil County	0	16	16
	Dorchester County	0	5	5
	Kent County	0	3	3
	Queen Anne's County	0	7	7
	Somerset County	0	4	4
	Talbot County	0	5	5
	Wicomico County	0	14	14
	Worcester County	0	7	7
	Total	15	798	783

Assessment of Financial Barriers to AFV Refueling Infrastructure Deployment in Maryland

Financial Barrier Literature Research and Documentation

In this task, a comprehensive literature research was conducted on recent (within the last five years) studies and reports documenting financial barriers to AFV refueling infrastructure development. The objective was to identify current and future financial barriers related to the deployment of public or private-sector (e.g., workplace) AFV refueling stations specific to Maryland. The alternative fuels considered for this exercise were CNG, E85, electricity, and LPG. The literature research covered sources documenting financial barriers in specific locations or regions of the country, barriers perceived as nationally applied, as well as barriers that have been identified internationally. The project information compiled from the AFV refueling station representative interviews discussed above were also utilized to identify additional financial barriers.

Having conducted the literature research, each barrier was assessed as to its application to Maryland. Those barriers found not to apply to Maryland were removed from further consideration. A database was then developed for listing the financial barriers identified for Maryland and their sources. A total of 19 financial barriers were identified and are listed in Appendix D. Note that some of the barriers identified apply to all four of the alternative fuel types under consideration, while others apply only to specific fuels.

Financial Barrier Categorization

As a means of delineating the financial barriers by type (and potentially facilitating their resolution under a future pointed pilot program), each previously identified barrier was assigned to one of four categories as follows:

- Business Case – barriers that impact the general business case for establishing or maintaining an AFV refueling station.
- Financial Production Limitations – barriers related to the establishment or terms of financial products for financing AFV refueling station equipment, operations or maintenance.
- Infrastructure Restrictions – barriers related to restrictions on AFV refueling equipment sizing or design and/or the alternative fuel supply infrastructure that serves a station.
- Education and Outreach – barriers that exist due to the lack of education, outreach or accurate information on AFV refueling infrastructure.

A summary of the financial barriers by category is shown in Table 12 below. Note that the Business Case category was deemed to have the highest number of financial barriers cited overall.

Table 12. Summary of Barriers by Category

Number of Financial Barriers by Category			
Business Case	**Financial Product Limitations**	**Infrastructure Restrictions**	**Education and Outreach**
8	3	5	3

Financial Barrier Rankings

For purposes of prioritizing the barriers and establishing the basis for the financing pilot program structure development presented below in this report, the aforementioned financial barriers were ranked in terms of their importance to Maryland's AFV refueling station deployment. The following criteria were utilized in developing the barrier rankings:

- Does the barrier apply to multiple alternative fuels? – A barrier that relates to several fuels receives a higher ranking since when addressed or eliminated, several AFV fueling technologies will benefit.
- If the barrier is solved, how much capital investment does it make available and how quickly? – A barrier that affords more capital in a shorter time frame is ranked higher.
- If the barrier is addressed, would it enable more public/workplace stations locally, regionally, or across the State? – Barriers that limit workplace and public access stations are of higher importance since these stations enable/serve broader AFV deployments and markets.
- In addition to limiting capital investment, does the barrier also impact AFV refueling station maintenance and operational costs? – A barrier that increases the maintenance and operational costs of a station impacts its long-term sustainability, and thus is of greater importance.
- Are there readily implementable and cost-effective solutions to mitigate or eliminate the barrier? – A barrier that can be addressed with cost-effective and more easily implementable solutions was ranked higher.

With these criteria in mind, the 19 previously identified financial barriers were ranked in terms of their importance to the State. The criteria were given equal weighting in assessing the ranking of each barrier. Those barriers deemed to satisfy multiple criteria were ultimately ranked higher.

Table 13 lists the top five ranked barriers from this analysis and are recommended for specific consideration in developing the basis of a financing pilot program that brings highest value for increasing the number of AFV refueling stations in the State in the near-term.

The top ranked financial barrier was the *High Capital Costs* associated with each of the alternative fuel infrastructure. The equipment costs alone for CNG, LPG, and E85 stations are

very high. This was reflected in the station survey information, and in the literature research, with equipment

Table 13. Top Five Ranked Financial Barriers

Rank	Category	Financial Barrier	AFV Fuel Type	Bibliography Reference
1	Business case	High Capital Costs for AFV Fueling Infrastructure Installations	ALL	4,7,8,9,11
2	Business case	Lack of Initial AFV Market: Lack of initial AFV market to drive market interest makes it difficult for stations to sell enough fuel to see a timely positive return on investment	ALL	6
3	Business case	E-85 Terminal Piping Limitations: ethanol blends higher than E10 are not available at MD terminals for a reasonable cost due to insufficient terminal piping. MD fuel marketers pay a premium for trucking E85 from out of state terminals and would have to pay a larger premium to obtain E85 from in-state terminals due to the piping limitations.	E-85	4,7,10
4	Financial Product Limitations	Financial Product Scale: The transaction costs associated with loan origination, attorney fees, monitoring, and servicing financial products are higher per product when only a few financial products are transacted. More transactions that use the same processes, templates and formulations reduce the per product cost. This applies to AFV refueling infrastructure loans in which there is very little experience base and limited standardized loan models to follow, creating higher loan-related costs.	ALL	1
5	Financial Product Limitations	Legal and Regulatory Hurdles: Rules about the kinds of financial instruments investors can hold, and restrictions on contract types and terms can both limit investment in AFVs and their infrastructure. This is especially true for government agencies, laws governing public procurement and the structure of competitive solicitations for goods and services can make some contracts, even ones that would save public agencies money, explicitly illegal.	ALL	1

costs vary from around $20,000 for an LPG station, $30,000 for an E85 station, and up to $1 million for a CNG station. These figures reflect only the equipment cost; there are also several other additive costs such as installation and permitting which result in high upfront costs for station owners. (It should be noted this barrier only applies to large LPG stations. For smaller stations, the propane supplier is generally willing to provide the infrastructure for very low upfront costs.) While capital costs for EV charging stations are generally lower compared with

the other alternative fuels, upfront capital costs can be significant if extensive site electrical upgrades are necessary and/or if Level 3 fast charging is being implemented. As with most business ventures, high upfront capital costs continue to be a primary impediment to wide-scale AFV refueling station implementation regardless of owner type (small station owner and to franchise company owner). Higher capital costs limit the regional number of stations that can be implemented for a given capital budget level, as well as impact the acceptable risk-reward ratios of prospective financial institutions due to the uncertainty and lack of experience with alternative fuel refueling infrastructure investments.

The second highest ranked barrier was the *Lack of an Initial AFV Market*. This barrier generally applies to all four alternative fuel types. In the early stages of local or regional AFV adoption there are fewer AFVs, leading to less fuel throughput potential for an alternative fueling station. Lower initial fuel throughput makes an alternative fueling station less attractive to potential station owners who perceive a limited positive return of investment, or a return on investment that is drawn out over an unacceptable timeframe. This negative forecast by potential station owners often prevents them from moving forward with a local or regional AFV refueling station project until a reasonable AFV population exists. This is the classic "Chicken and Egg" syndrome. While this barrier generally applies to all types of station owners, it may impact small station owners more significantly than large station or franchise company owners. For small station owners, slow revenue growth can significantly impact overall station cashflow, especially for stations that are displacing some of its revenue-producing conventional fuels like gasoline and diesel fuel with the alternative fuel. For larger station owners or owners with higher capital backing, the loss of short-term cashflow is less significant and could be more easily tolerated, especially when implementing a regional network of stations; however, implementation decisions regarding timeframe and locality could still be significantly impacted. Exacerbating the impacts of the initial AFV market barrier is a lack of consumer awareness regarding local/regional alternative fuel infrastructure, and the potential for a siphoning of public access station demand by growing residential-based refueling/recharging infrastructure. The latter is especially true for public EV recharging stations, and potentially for CNG public stations if CNG home refueling products become established in the market.

The third ranked barrier was *E85 Terminal Piping Limitations*. Research for this task determined that E85 is currently available from terminals in Baltimore, Maryland, but that piping infrastructure capacity limits E85 pumping rates to tanker trucks at these facilities, resulting in unreasonable tanker truck filling times. For this reason, terminal facility owners charge higher rates for E85 deliveries to retail stations, which translates to higher E85 retail pump prices, a further disincentive for flexible fuel vehicle (FFV) owners to fill up on the fuel. This barrier could be solved by increasing the E85 piping capacities at the terminal locations, but terminal owners do not want to spend the necessary upfront capital for serving what they view as a low

throughput fuel with limited potential return on investment. This barrier impacts both small and large/franchise station owners since the E85 terminal costs are assigned at the wholesale level and passed on equally to the retail distribution infrastructure. Addressing this barrier would ultimately lead to lower E85 retail pump prices, thus encouraging the more than 290,000 existing FFVs in the State to use E85 fuel.

Financial Product Scale was ranked as the fourth highest barrier and generally applies to all alternative fuel types and negatively impacts the potential financing station owners might receive for new infrastructure. This barrier pertains to the lack of standardization for AFV refueling station financial products due to a general lack of experience with this type of financing application. The lack of standardization leads to higher financial product costs, less flexibility in terms, and a lower number of overall product options. All of these issues may prevent potential AFV refueling station owners from pursuing station financing options for future station installation projects. A more standardized financial product system set up specifically for AFV fueling stations would lower the perceived risk level by investment groups and decrease associated product costs, while increasing available options to station owners. The standardized financial products could also be geared to type of alternative fuel and/or throughput size of the station. For example, a standard financial product for EV charging stations versus one for CNG stations might be beneficial from the standpoint of the differences in their typical capital requirements and station throughputs. Further, there will likely be differences in future market acceptance and growth among the alternative fuels types such that standardization of readily available financial products may be of greater importance for one fuel over another in supporting or accelerating continued market growth.

The fifth ranked barrier is *Legal and Regulatory Restrictions Related to Financial Investments*. This barrier pertains to restrictions on financial instruments investors can hold. Banks are highly regulated with regards to what types of investments can be made in relation to risk. Alternative fuels are generally regarded as high risk investments given the lack of market experience and demand, making it very hard for Investors such as banks, pension funds, and insurance companies to invest in them. It should also be noted that there are governing laws in public procurements and competitive solicitations that make certain contracts illegal, even if they could benefit the public entity providing them[8]. While this barrier does not generally apply directly to station owners, it does limit the potential funding investments in AFV refueling infrastructure, thereby limiting the potential financing options and capital available to station owners, and very likely, the stations built in Maryland.

Appendix D lists the remaining fourteen barriers identified in this task and their associated lower rankings based on the aforementioned analysis. A summary of these is as follows:

- Liquidity Risk – The uncertainty associated with new technologies such as alternative fuels infrastructure makes investments in them harder to buy and sell by financial institutions.

  This liquidity challenge requires institutions to hold higher reserves to offset this risk.
- Public Entities Unable to Use Incentives – Public entities are unable to take advantage of incentives such as tax credits or grants, thereby limiting potential infrastructure market growth. This is especially important for the critical early infrastructure period under which government institutions can lead "Lead by Example" and spur future growth.
- Lack of Utility Infrastructure Availability/Capacity – The lack of supply infrastructure can limit local and/or regional station implementation due to the higher costs associated with establishing supply or increasing capacity. This includes local site electrical upgrades that may be necessary for operating refueling equipment.
- High Demand Charges – CNG refueling and EV recharging stations may experience high demand charges if located in competitive local/regional markets or within regions with supply or capacity issues.
- Lack of Renewable Fuels Standard – The delay in setting the Renewable Fuels Standard has produced uncertainty in the E85 supply/demand market, resulting in potential cost impacts for both wholesalers and retailers of the fuel.
- Lack of E85 Fuel Education/Outreach – There is a lack of understanding and market acceptance regarding the use of E85 fuel among the more than 290,000 flexible fuel vehicle owners in the State as evidenced by the low reported annual E85 usage figures. Greater education/outreach focused on FFV owners could improve E85 fuel utilization among this population, thereby creating fuel demand and improving the business case for more E85 stations in the State.
- Higher Insurance Premiums – Alternative fuel station owners may experience higher insurance rates due to perceived higher safety risks.
- Private Fleet Fueling Preference – With the exception of EVs, AFVs tend to be utilized more in fleet applications. Many fleets, especially CNG and LPG fleets, tend to establish their own associated private refueling infrastructure, which negates market demand for public stations and the resulting local/regional business case for public stations.
- Lack of Industry/Government Partnerships – The lack of partnering has limited the potential for local/regional infrastructure solutions by creating fuel demand, sharing capital and operational costs, and reducing education, and outreach costs.
- Lack of Licensed/Qualified Contractors – The lack of local/regional licensed or qualified contractors can result in higher, less competitively bid station costs if out-of-State contractors must be solicited for station bids.

- Information Failures – The general lack of credible information concerning alternative fuel infrastructure leads to higher perceived risk among financial institutions, limits local/regional AFV market growth, and creates uncertainty in station ownership business fundamentals.

Assessment of Potential Financing Mechanisms for AFV Refueling Infrastructure Implementation

There are a variety of financing mechanisms that can be considered to address Maryland's barriers to developing alternative fuel vehicle infrastructure. Some of these incentives are commonly administered by federal, state, and local governments for AFV infrastructure such as grants and rebates. Other types of financing mechanisms that are commonly used for building energy efficiency and renewable energy projects could also be adapted for an AFV infrastructure program.

The following section describes a number of potential financing mechanisms that were identified from the technical literature and through discussions with government and industry representatives. In these descriptions the potential AFV refueling infrastructure owner or lessor is referred to as the consumer. For each mechanism, potential benefits and challenges for its implementation are indicated, as well as an assessment of how it might address the five top ranked financial barriers in Maryland identified above and listed in Table 13.

Direct Loans

A competitive direct loan program can be offered for AFV infrastructure projects that provide better financing options for consumers compared to private lenders. Loans can be provided to consumers that have difficulty qualifying for a private loan, offer lower interest rates, offer longer loan terms, or provide loans for smaller quantities than what a private lender is willing to pursue. Maryland has experience providing direct loans in programs such as the Jane E. Lawton Conservation Loan Program which provides financing for nonprofits, local governments, and businesses to make energy-saving upgrades. Since many lenders are reluctant to offer small loans, such as lower than $5,000, direct loans could be offered for smaller projects and combine those loans into a" warehouse" that can then be sold to private investors. Connecticut's Green Bank currently uses that model for building energy efficiency projects.

General Benefits:

- MEA would have control over designing the loan program to best fill the financing gaps or limitations currently available to consumers.

- MEA has experience creating and managing direct loan programs, especially for non-residential borrowers.
- Reducing AFV fueling infrastructure providers' monthly loan payments can help provide time for utilization of the fueling infrastructure to grow as the market for alternative fuel vehicles grows.

General Challenges:

- Direct loan programs would require MEA to provide the upfront capital and have that capital be tied up for extended periods of time.
- MEA would hold all of the risk for a loan default and would be responsible for all of the loan management.
- In order for a consumer to choose to apply for a loan for AFV infrastructure, they need a guarantee that vehicles will utilize the infrastructure and a strong business case that they will see a return on the investment. This may be difficult for consumers in the immature AFV market that is foreseen for the near future.

Potential AFV Barriers Addressed:

- 1, 2, 3

Barrier Application Analysis:

1. High Capital Costs – Direct loans could be advantageous for high capital cost infrastructure such as CNG stations and large LPG stations. CNG stations in particular tend to serve medium/heavy duty trucks that consume larger amounts of fuel, and consequently tend to be served by higher throughput (and thus higher capital cost) stations. Direct loans could also be useful for offsetting annual station maintenance costs which are often unforeseen and are significant cash flow impacts. In terms of E85 stations, station owners surveyed as part of this contract indicated they would be particularly interested in low interest loans. Station equipment and installation costs are significant and can be challenging for some station owners, especially non-franchised owners. Owners surveyed said they would prefer six years or less for ROI, so loans could be established for supporting this general timeframe. Loans (along with other types of mechanisms) could be used to support quick regional station growth for serving regional populations of Flexible Fuel Vehicles (FFVs). Innovative approaches to loan use could involve offsetting operational costs such as station marketing to engage local/regional FFV owners. The largest drawback to the use of loans for E85 stations is the lack of initial station throughput which reduces the ability for loan pay back. Although a potentially useful financial tool for EV charging stations, loans are probably less critical as station capital and operating costs are much lower(typically $6,000-

10,000). However, loans could be customized to match location needs (multiple chargers, Level 2 and Level 3 capabilities, etc.), and/or bundled for multiple locations for serving owners of multiple stations. Perhaps the best use of loans for recharging stations is a customized loan for quick funding geared towards smaller capital levels to keep pace with growing local and regional EV populations.

2. Lack of Initial AFV Market – For some station owners, loans could help offset some of the ownership risk for what may be low station ROI initially due to lack of local or regional AFV markets. In the case of high capital cost and/or large stations for CNG and LPG, loans could help owners and investors to extend 3-5 year ROI expectations and need for immediate returns when utilization is low. For E85 stations, the AFV market is typically not an issue given the more than 290,000 FFVs in the State, but E85 fuel use is, so loan payback is still a potential problem. In the case of EV recharging stations, short-term loans could support small newly-established stations in terms of stretching cash flow until local/regional EV markets get established.
3. E-85 Terminal Piping Limitations – Loans could be a useful financial instrument for addressing the capital investments necessary for updating the bulk terminal E85 piping in Maryland. Loans treated as "infrastructure" with longer payback terms might be more advantageous to terminal owners. The upside of addressing the terminal piping is lower terminal rack prices for E85 resulting in lower E85 station pump prices for the more than 290,000 FFVs in the State. However, some terminal owners may be hesitant to take on a loan and its payback restrictions when near-term regional E85 fuel demand is deemed to be low.

Credit Enhancements

A variety of credit enhancements can be provided to encourage private investors to support AFV infrastructure projects. Credit enhancements reduce the credit risk of a debt and can thereby result in lower interest rates and longer loan terms for consumers. Credit enhancements are innovative tools that use minimal public funding to leverage private investment. Encouraging private lenders to engage in loans for new technologies can have a long term positive impact on future financing for that technology by enabling lenders to become more familiar with these types of projects. Maryland is becoming more familiar with utilizing credit enhancement programs and has authority to offer credit enhancements for commercial financing. For example, MEA was heavily involved in the design of credit enhancements for the Maryland Clean Energy Center's Maryland Home Energy Loan Program. Possible credit enhancement mechanisms include loan loss reserves, loan interest rate buydown, loan guarantees, loan insurance, and debt service reserve funds as described below.

- Loan Loss Reserve (LLR) – A loan loss reserve is a cash account to cover potential losses on the loan due to defaults. Funds would be contributed to a LLR to reduce the lender's

risk and reduce the amount of capital the lender must tie up in the loan process. The LLR contribution could be in the first loss position or the second loss position. In the first loss position, a percentage of the loan loss would first come out of the LLR account. In the second loss position, the lender must pay a percentage of the loan loss before the LLR is used to cover the next portion of the loss.

CEFIA uses a LLR credit enhancement for their Smart E Loan program. The program covers 40 types of residential energy efficiency projects, including electric vehicle recharging and natural gas vehicle refueling stations. Through intensive lender recruitment, they have nine lenders who have agreed to participate in the program and meet the program's maximum interest rate for specified terms. The program loan terms and maximum rates are 5yrs/4.49%, 7yrs/4.99%, 10yrs/5.99%, and 12yrs/6.99%. If the consumer's FICO score is above 680, CEFIA contributes 7.5% of the loan to the LLR. If the FICO score is 640, Authority CEFIA contributes 15%. The LLR is a second-loss program. The lender is responsible for the first 1.5% of losses and then the CEFIA will cover additional losses for up to about 9%.

In the fall of 2014, the California Pollution Control Finance Authority (CPCFA) announced their Electric Vehicle Charging Station (EVCS) Financing Program which uses a LLR. This program was accepting comments until December 8, 2014 and has not yet started accepting applications. The program targets business owners financing electric vehicle charging infrastructure projects. All financing terms are determined between the lender and the business owner. The lender enrolls all or a portion of the loan or lease in the EVCS program. CPCFA contributes 20-30% of the loan to the LLR for that lender. The borrower has the opportunity to receive half the LLR as a rebate after 48 months of making timely loan payments.

- Interest Rate Buydown (IRB) – Through a loan interest rate buydown, the lender would get paid to lower the customer's loan interest rate or pay a portion of the loan interest. The buydown could be offered for a portion of the loan term or for the entire term.
- Loan Guarantee – With a loan guarantee, the debt obligation of the borrower would be covered in case the borrower defaults. A loan guarantee can be limited to a portion of the debt or cover the entire loan. A loan guarantee can help borrowers who would not qualify for a loan based on their own creditworthiness access financing. It also can enable the borrower to obtain a lower interest rate.
- Loan Insurance – Loan insurance has many of the same characteristics as a loan guarantee. Loan insurance can insure a percentage of the loan against default.
- Debt Service Reserve Fund – A debt service reserve fund is capital that is set aside to compensate lenders if a borrower is overdue on a loan payment. Once the borrower makes the overdue payment, the lender returns the compensation to the debt service

reserve fund. This type of credit enhancement may require less capital than other types.

General Benefits:

- Credit enhancements are highly effective mechanisms for using minimal public funds to leverage private investment.
- Using credit enhancements rather than direct loans requires less upfront capital from MEA and reduces MEA's risk of loss.
- They enable private loans for an emerging market where borrowers are having a difficulty accessing loans, competitive interest rates, or terms long enough for the borrower to see a return on the investment.
- A long term benefit of credit enhancements is private lenders becoming more familiar with the new market and able to offer more competitive loans.
- Increasing the number of loan transactions using the same processes, templates and formulations can reduce the lender's cost for each loan.
- Reducing AFV fueling infrastructure providers' monthly loan payments can help provide time for utilization of the fueling infrastructure to grow as the market for alternative fuel vehicles grows.

General Challenges:

- A credit enhancement program requires intensive lender education, recruiting, and collaboration in order for them to participate in the program.
- In order for a consumer to choose to apply for a loan for AFV infrastructure, they need a guarantee that vehicles will utilize the infrastructure and a strong business case that they will see a return on the investment. This may be difficult for consumers in an immature AFV market.

Potential AFV Barriers Addressed:

- 1, 2, 3, 4, 5

Barrier Application Analysis:

1. High Capital Costs – Credit enhancements would support the application of loan programs for high capital cost stations for CNG, large LPG stations, as well as multiple station locations such as the case for EV recharging. These enhancements would be beneficial from both the perspective of new station owners as well as private investors looking to support loans for AFV refueling infrastructure. Station owners would benefit from lower interest rates and less restrictive creditworthiness criteria, potentially allowing for higher or more flexible loan programs, for high capital cost stations. For

private investors, the backing of infrastructure loan programs with loan loss reserves and other types of capital loss protection may reduce the perceived risk such that private capital investment can complement other funding reserves to back higher capital cost station deployments.

2. Lack of Initial AFV Market – Credit enhancements would directly address the chicken and egg problem with AFV markets and AFV refueling station deployment. By backing loan programs with credit enhancements that benefit both station owners and private investment, perceived risk due to unestablished local or regional AFV market would likely be reduced allowing for a greater number of loan applications (leading to a higher number of stations) and a greater level of private sector investment in infrastructure loans.
3. E-85 Terminal Piping Limitations – Credit enhancements could support the resolution of the E85 terminal piping issue by improving loan terms as viewed by bulk terminal owners. If bulk terminal owners can secure loans customized for the E85 piping upgrades and with advantageous terms, they may be willing to accept longer ROIs on their investments until higher E85 throughputs are seen in the market. With the terminal piping upgrades, E85 rack prices should be lower which in turn should lower E85 pump prices, enticing FFV owners to use more E85 fuel and increase throughput at both stations and bulk terminals.
4. Financial Product Scale – Credit enhancements would allow more flexibility in AFV refueling infrastructure loan terms and options. This in turn should spur private sector investment with an increased number of creative loan programs that match station owner needs and future market directions. With this greater flexibility, loan products could be aimed at specific type of infrastructure, and a greater variety of products could be offered to new station owners to accelerate the market.
5. Legal and Regulatory Hurdles – Alternative fuel refueling infrastructure is generally regarded as a high risk investment given the lack of market experience and demand, making it hard for investors such as banks, pension funds, and insurance companies to justify investment. Through credit enhancements that are supported by legislation/regulation, these entities would theoretically have more freedom to provide loan mechanisms for supporting infrastructure.

Grants

Grants are a common government incentive for AFV infrastructure. The government entity identifies specific project criteria, requests proposals that meet the criteria, and awards funding to the applicants that best fit the funding purpose. Grants can leverage private investment by requiring applicants to contribute cost share to the total project costs. Typical applicant cost share ranges from 25% to 50% of the total project. Grants can include the requirement that a

station owner continue to sell the alternative fuel for a specified period of time otherwise the grant money would need to be returned.

General Benefits:

- Managing grants is a straightforward and familiar process for a government agency.
- Applying for and using grants is also a straightforward and familiar process for many consumers.

General Challenges:

- Grants would require a large amount of upfront capital from the government entity in the case of AFV refueling infrastructure.
- Although cost share can be requested, grants are not the most effective mechanism for maximizing public funds leveraging private investment.

Potential AFV Barriers Addressed:

- 1, 2, 3

Barrier Application Analysis:

1. High Capital Costs – Grants can be a significant tool in addressing typically high capital costs for public access CNG stations and large LPG stations. CNG station owners that were surveyed especially indicated their interest in grants to help offset their initial capital investment. These stations tend to serve medium and heavy duty vehicles and thus require larger fuel throughputs and consequently higher cost equipment. Another benefit of grants for these stations could be to offset annual maintenance costs often unforeseen and may have significant cash flow impacts. This application of grants could assist in making CNG stations a more sustainable business model for some owners. In the case of E85 stations, most Maryland station owners surveyed received grants in establishing their stations. E85 station costs can be challenging for owners, especially multi-E85 island stations. And because E85 is typically added to an existing gasoline service station and therefore likely to displace existing gasoline fuel sales, grants can stretch assist with cash flow expectations especially early in E85 ownership. Further, grants could be offered that support both equipment installation and E85 product marketing, thereby assisting owners in getting the word out to the 290,000 FFV owners in the State. For EV charging stations, the best use of grants may be to quickly jumpstart station development in underserved counties and localities with growing EV populations. Grants could also be offered specifically for establishing recharging stations in strategic areas of the State (rest stops, truck stops, and key highways) for supporting longer range intrastate EV travel as well as interstate travel. Of course, these strategic locations could have an added benefit of marketing EV and recharging

technology in general to a broader market. One drawback for grants, especially as related to high capital cost (e.g., CNG) and large stations, is State funding limits. In these cases, a lower number of stations can be funded at a given grant program funding level unless significant cost share requirements are attached to the grants thereby leveraging available State funds. However, upfront cost share can be an obstacle for some station owners or investors.

2. Lack of Initial AFV Market – For CNG stations, grants for supporting station builds could be a way for extending ROI expectations (typically 3-5 years) when initial CNG vehicle utilization of the stations may be limited. Similarly, the initial AFV market in the State for E85 stations is not a problem, but the use of E85 fuel in those vehicles is. In these cases, grants can support short-term cash flow issues due to low initial station utilization by FFVs, but are not likely to support regional or sustained growth due to likely State funding limitations. While this barrier is less relevant for EV charging stations since EVs are the fastest growing AFV in the State, grants would support station ownership by stretching station cash flow and allowing for longer ROI schedules. In general, grants could help address the lack of an initial AFV market for stations and its corresponding low cash flow, but limits on amounts of State funding make grants less compelling to "drive" market growth. Grants may possibly be better applied to jumpstart regional markets to support placement of stations in critical localities to support broader utilization and long-term growth.
3. E-85 Terminal Piping Limitations – Grants are probably the most promising instrument for addressing the E85 terminal piping issue in Maryland. Terminal owners may have concerns over taking out loans for the necessary infrastructure improvements with the low likelihood of immediate payback due to lagging E85 fuel sales in the State. A grant can be specifically applied to the terminals and the piping upgrades, resulting in lower terminal rack prices that entice station owners to purchase the fuel in Maryland, which then benefits all Maryland-based E85 stations and FFV owners with lower pump fuel prices. Grants would also be very effective in practice in that they can be focused on a limited number of facilities (in this case, Maryland-based bulk terminals) but would benefit a large number of downstream facilities (in this case, E85 stations), and ultimately, State vehicle (FFV) owners. Grants would provide a significant "bang for the buck" in terms of positive impacts to the marketplace for this situation.

Rebates

AFV refueling infrastructure can be incentivized through a rebate program that provides funding to the project developer after the infrastructure has been installed. A rebate could include the requirement that a station owner continue to sell the alternative fuel for a specified period of time otherwise the rebate would need to be returned. Rebates can exist as a

standalone incentive or they can be incorporated into a larger financing program. Arkansas offers rebates for CNG, LNG, and propane fueling stations for 75% up to $400,000. The California Electric Vehicle Charging Station (EVCS) Financing Program primarily features a LLR account but it also includes a rebate for 10-15% of the loan. The rebate is provided after the loan or lease is retired or within two years. Borrowers are only eligible for the rebate if they have no more than one late payment.

General Benefits:

- Managing rebates is a straightforward and familiar process for a government agency.
- A rebate program does not require the project application and award process prior to developing the infrastructure.
- Applying for rebates is a straightforward and familiar process for many consumers.
- Consumers appreciate the certainty of knowing they will receive the rebate if they complete the project.

General Challenges:

- The government agency does not have as much control over managing the program budget and generally is not informed about a project until after it has been completed. This decreases the ability to ensure the funding goes towards the projects that best meet the program's priorities.
- Rebates that cover a higher portion of the total project costs are more utilized by consumers but do not maximize public funds leveraging private investment.

Potential AFV Barriers Addressed:

- 1, 2, 3

Barrier Application Analysis:

1. High Capital Costs – Similar to grants, rebates would be an effective financial mechanism for supporting all alternative fuel refueling stations, especially high cost or large stations. While rebates would likely be applied directly to offsetting the payback of capital costs for building the stations, they might also be applied by station owners to assist in offsetting annual maintenance costs or other cash flow impacts early in ownership. Rebates might allow owners to obtain other types of financing (e.g., loans or private investments) by insuring early ROI, providing insurance against near-term cash flow issues, or offering virtual collateral. Rebates could help jumpstart station ownerships in underutilized counties or regions such as for fast growing EV recharging. While there would be limits to the amount of rebate funding the State could allocate, they might drive a larger number of stations to be established compared with grants

since rebate amounts would likely be smaller in nature and thus significantly leverage external funding per station.

2. Lack of Initial AFV Market – Rebates could help address this barrier by taking some of the financial risk out of investing in stations that may have low ROI rates until local/regional AFV markets are established. The rebates may be especially important for high cost and large stations requiring substantial capital investment. While rebates would be effective in addressing this barrier and its corresponding low cash flow impacts on stations, limits on the amounts of State funding programs will likely make rebates less compelling to "drive" widescale AFV markets. A better use for rebates may be to jumpstart regional markets for critical localities to support broader utilization and long-term growth.
3. E-85 Terminal Piping Limitations – A rebate program could support investment in the necessary bulk terminal infrastructure upgrades for addressing this barrier by offering an effective near-term ROI on the investments. Research has indicated that current terminal owners are hesitant to make the investment for these upgrades due to the lack of a significant E85 fuel market in the State. The use of a rebate program may encourage terminal investment as the rebate would be seen as an immediate ROI and assist in stretching payback schedules until E85 throughput at the terminal increases. However, compared with grant programs to address this barrier, rebates may be less effective in that terminal owners or investors would likely need to cover the entire capital expense upfront in order to obtain the rebate after the upgrades are completed. This is a less compelling financial situation for station owners compared with a grant that would displace most or even all of the capital expense upfront.

Off-Balance-Sheet Financing

Some consumers are unable or unwilling to take on additional debt to finance a project. In these instances, consumers would prefer an off-balance-sheet (OBS) financing option where the cost of the capital is tracked on the books of a third party. Using this type of financing helps consumers keep their debt-to-equity ratios low. Examples of OBS financing include leases, on-bill financing, commercial property assessed clean energy, and working with energy service companies. In general, OBS financing allows projects to be funded out of operating budgets rather than capital investment.

- Leases – A lease program provides consumers the option to have a third-party finance, build, and own the AFV infrastructure while the consumer is able to utilize the infrastructure. The consumer pays the third-party for using the infrastructure through a monthly fee, energy cost savings, or other process. The consumer generally has the option to own the infrastructure after a specified period of time. In energy efficiency projects, the lease model can be a seamless process where the consumer provides no

upfront capital and the investment is paid off directly through the energy cost savings. Maryland can encourage leases by offering financing options to third-parties seeking to build AFV infrastructure and providing leases to consumers.

The CT Solar Lease program enables property owners to lease a solar photovoltaic or solar hot water system for no upfront costs. The consumer makes monthly payments for 20 years with the option to purchase the technology at five years. This program is integrated with the CT C-PACE program. It also includes a Performance-Based Incentive where the home owner can pay the lessor based on actual performance over the course of six years. CEFIA collaborated with lenders to create this program. The program provides local solar companies a sales tool to promote an affordable financing option to consumers.

General Benefits:

- Consumers benefit from affordable financing without the risk and responsibilities of owning the infrastructure.
- The owner of the infrastructure may be in a better position to benefit from tax benefits from building the infrastructure and can pass these savings on to a consumer that would not otherwise qualify for tax benefits.

General Challenges:

- A third-party must have a sufficient business case to build the AFV infrastructure and providing the customer a lease.
- Customers may prefer to own their AFV infrastructure and have more control over its operations.

- On-Bill Financing – On-bill financing is a service offered by utilities which allows consumers to repay an energy efficiency loan in monthly installments on a utility bill.

General Benefits:

- This model allows consumers to initiate an energy efficiency project for little upfront funding.
- This is a lower-risk loan because utility bills have a lower rate of non-payment than other bills.

General Challenges:

- This model requires coordination between the utility, infrastructure provider, lender, and consumer.
- The utility may not have an interest in participating in this model for AFV infrastructure if they are not involved in the ownership or construction of the fueling infrastructure.

- Commercial Property Assessed Clean Energy (C-PACE) – Through a C-PACE program, consumers obtain financing for an energy project and repay it as a charge on their property tax bill. The financed energy improvements increase the building's value while preserving the building owner's capital for other investments. Through the CT C-PACE program customers access 100 percent up front financing and can spread payments out for a period of up to 20 years. In 2013, CEFIA approved 26 C-PACE projects totaling $20 million.

  General Benefits:

  - Consumers have access to low up front financing and are able to pay back the loan over a long period of time. The repayment obligation transfers automatically to the next owner if the property is sold.

  General Challenges:

  - Due to the structure of Maryland's independent counties, a C-PACE program would be complicated and difficult to implement in the near-term.
  - Maryland's PACE statute does not currently include alternative fuels.
  - This model would be difficult to implement if the station owner does not own the property.
- Energy Service Companies (ESCO) - Energy service companies (ESCOs) and energy savings performance contracts (ESPCs) are used for building energy efficiency upgrades. With this model, the upfront capital costs are financed by an ESCO and the consumer repays the ESCO through energy cost savings accrued over time. The ESCO prepares a front-end evaluation for the consumer which determines the cost of the project and the anticipated energy cost savings. If the ESCO and client choose to move forward with the station project, they enter into a service contract including the scope of work, project costs and fees for service, and any agreed upon guarantees of project performance. ESCOs are more popular with government, university, school, and hospital clients since they have a higher tolerance for projects with longer payback period and reduced focus on maximizing investment return.

  An ESCO framework, with contracts based on ongoing fuel savings, can help finance AFV infrastructure for customers that own the infrastructure and the vehicles that fuel at the infrastructure. This would be most applicable for electric vehicle charging stations, CNG stations, or propane stations as these fuels typically have fuel price savings compared to conventional fuels. The ESCO model could be supported by recruiting ESCOs, promoting the model to consumers, creating standard service contracts and processes, and offering risk reduction or financing services to the ESCO.

  General Benefits:

- Helps remove the hurdle of high upfront cost for the building operator and reduces the effect of other barriers such as risk aversion and lack of information or experience with the technology.
- The owner of the infrastructure may be in a better position to benefit from tax benefits from building the infrastructure and can pass these savings on to a consumer that would not otherwise qualify for tax benefits.

General Challenges:

- ESCO models for AFV infrastructure are more difficult to arrange than efficiency upgrades in buildings since they are impacted by the quantity of vehicles that use the infrastructure, vehicle operation, price of the alternative fuel source, and price of the conventional fuel. For instance, since the majority of energy cost savings from a natural gas vehicle infrastructure project come from the reduced price of natural gas compared to conventional fuel rather than a reduction in energy use, it is difficult to guarantee the project performance in advance. A natural gas provider can guarantee the natural gas fuel price. However, the price of the comparative conventional fuel may fluctuate therefore; the exact fuel price spread cannot be guaranteed. The vehicle manufacturer may be able to guarantee the vehicle fuel economy performance but vehicle operation can vary based on driver habits and duty cycle.

Potential AFV Barriers Addressed:

- 1, 2, 4, 5

Barrier Application Analysis:

1. High Capital Costs – OBS financing could be an attractive option for some station owners and investors since they eliminate or reduce the amount of upfront capital costs needed for establishing the stations. Payback is achieved through regular payments based on operational revenues and/or savings passed on the investors over time. OBS, specifically leasing through fuel supply and refueling service companies, has been an effective financing alternative for high cost CNG stations for many years.
2. Lack of Initial AFV Market – Similar to other financial mechanisms, OBS could help address this barrier by eliminating upfront costs and reducing the immediate need for a local or regional AFV market for fuel sales and capital payback. However, since OBS funding payback is based on station operations, the initial AFV market expectations would still be a strong consideration for both investors and station owners in establishing OBS financing.
4. Financial Product Scale – By their nature, OBS financing solutions address this barrier by providing non-traditional financing options for station owners and investors. With the application of some or all of these options, greater market experience is gained

with these types of transactions, thereby improving the range and scale of financial products over time.

5. Legal and Regulatory Hurdles – OBS mechanisms offer more ways for investors and station owners to support refueling infrastructure development. For those entities that are restricted by legislative or regulatory provisions in the types of financial transactions they can participate in, OBS options offer significant alternatives to explore and possibly apply to achieve infrastructure placement goals.

Qualified Energy Conservation Bonds

Qualified Energy Conservation Bonds (QECBs) enable state, tribal, and local governments to offer financing to customers at an attractive rate for energy projects. They are a low-cost public financing tool subsidized by the U.S. Department of the Treasury. QECB proceeds can be used to deliver low-interest loans for a variety of energy projects including energy efficiency projects and alternative fuel vehicle infrastructure projects. QECB were originally established by the Energy Improvement and Extension Act of 2008. The American Recovery and Reinvestment Act of 2009 expanded the QECB issuance capacity from $800 million to $3.2 billion. States and local governments are allocated a specific amount of funding for QECB and can choose how to use that funding within the QECB regulations.

A QECB enables qualified government issuers to borrow money at low rates to fund energy projects; QECBs are not grants. A QECB is among the lowest-cost public financing tools because the U.S. Department of the Treasury subsidizes the issuer's borrowing costs. The most common applications for QECBs to date are for funding energy conservation projects in publicly owned buildings. However, QECBs can be used to fund capital investments in a variety of other projects including transportation.

There are challenges to QECB programs. For instance, if a state has many local governments over a certain population then total resources must be allocated smaller amounts which can also drive up administrative costs and draw out project implementation. This is important since only 2% of QECB issuances can be used for administrative costs. Further, some states have statutory debt volume ceilings and may be unwilling to issue QECBs against that ceiling.

General Benefits:

- QECBs are an attractive low-cost public financing tool using federal funding that provide significant flexibility
- QECBs leverage private investment.

General Challenges:

- Lack of State control on how funds are spent at the local level.
- The issuance process takes considerable time investment for the administrative entity.

- There is currently no mechanism for reallocating local allocations back to the State.
- Administrative costs can be higher in relation to amounts of capital raised.
- Applications to commercially-owned equipment and property are unclear.

Potential AFV Barriers Addressed:

- 1, 2, 3

Barrier Application Analysis:

1. High Capital Costs – QECBs may be another means of addressing high capital costs for installing stations in some regions of the State. QECBs may be used to fund station clusters in critical local or regional areas for supporting future AFV market growth in those regions. However, there may be limits on both station funding and location, as QCEBs are typically administered at the local or county government level with their associated implementation restrictions. It is also unclear how QCEBs might be applied to commercial enterprises like refueling stations. In the least, QCEBs could afford a way to fund public access refueling/recharging infrastructure at municipal-, county- or state-owned locations in critical areas like rest stops.
2. Lack of Initial AFV Market – QCEBs may be effective in supporting alternative fuel refueling/recharging infrastructure growth in critical areas for growth or for emerging AFV populations such as EVs. QCEBs could spur AFV markets by funding public access stations on municipal, county-, or state-owned properties. These stations would support AFV growth, enabling the future establishment of other commercially-based stations in the same localities or regions that serve the growing AFV populations. Questions remain, however, on the application of QCEB funds for station establishment in terms of required station ownership and operation, funding levels relative to overall program allocations for other types of energy projects, and program administration at the state and sub-state levels.
3. E-85 Terminal Piping Limitations – QCEBs in concept could be used to fund upfront capital costs needed for E85 piping changes at bulk terminals, similar to loans and grants. The capital raised would ensure the piping upgrades are made, resulting in lower terminal rack E85 prices for station owners, and ultimately lower pump prices for the State's FFV owners. This would obviously provide a statewide benefit. However, QCEBs have traditionally been applied to publicly-owned buildings and infrastructure, so it is unclear how QCEB proceeds could be applied to commercial operations like bulk terminals. Further, given that QCEBs are typically administered for projects at the local or county government level with intent that the resulting benefits reside within those localities, it is unclear how QCEBs might be applied to localized bulk terminal assets that ultimately benefit the entire state.

Evaluation of Potential Financial Mechanisms for Maryland

Having identified the plethora of possible financial mechanisms for supporting future alternative fuel infrastructure development in the State, an analysis was conducted for assessing the mechanisms that could be most effective if applied in Maryland. The following criteria were utilized for purposes of this evaluation:

- Ease of MEA Implementation and Administration – A mechanism that is more easily implemented and administered by MEA in near-term (two-year) timeframes is preferred.
- Applies to Multiple Alternative Fuels – A mechanism that can benefit infrastructure for several types of fuels is preferred.
- Offers Statewide Infrastructure Growth Potential – A mechanism that benefits workplace and public access stations across the State is preferred.
- Addresses Multiple Top Five Financial Barriers – A mechanism that assists in addressing several of the top five financial barriers identified for the State is preferred.
- Requires Lower Capital Investment by the State – A mechanism that allows lower capital investment by the State is preferred.
- Offers Lower Risk by the State – A mechanism that affords the State lower financial risk is preferred.
- Leverages External Investment – A mechanism that has a higher degree of external investment that leverages State investment and/or costs is preferred.
- Offers Flexibility in Meeting Market Financial Needs – A mechanism that offers flexibility in its application and process is preferred.

Based on these evaluation criteria, the previously identified financial mechanisms were evaluated. Criteria were assigned Y-Yes, N-No, or O-neutral. The "O" assignment was given when a criterion was only partially or conditionally achieved. In terms of importance, the "Ease of Implementation and Administration" criterion was deemed equal to all of the other criteria combined.

Table 14 illustrates the results of the evaluation for each financial mechanism. Note that only the Direct Loans, Credit Enhancements, Grants, and Rebates mechanisms were determined to be readily implementable by MEA within two years. This assessment is based on the ability of these programs to be effectively established and operated and MEA's prior experience in administering programs like these in the past.

A Rebates program may hold the most promise of the three mechanisms that can be more easily implemented by MEA in the near-term. Rebates offer considerable flexibility in how they can be applied to infrastructure to accelerate deployment in terms of funding amounts, timeframes, and insurance for a variety of owners, and can be geared towards all fuel types.

They also typically involve less capital investment per station, leveraging external funding to achieve station implementation. This leveraging affords less investment risk by the State while also allowing greater station deployment potential for a given program budget level.

While deemed less viable than Rebate programs, Direct Loans and Grants still offer significant alternatives, especially when applied to smaller, low cost stations such as electric recharging stations. Grants will likely have lower administrative costs than Direct Loan programs, and may offer higher potential for cost leveraging with external funding sources through cost share stipulations. The various credit enhancement mechanisms could be implemented very effectively in concert with Direct Loan program or to enhance a private sector based loan program.

The Off Balance Sheet Financing mechanisms, while innovative alternatives to more traditional programs, require greater coordination with outside organizations, resulting in longer implementation schedules, less State control, and likely higher administration costs. While most of these mechanisms could be applied to any type of alternative fuel, they are more likely to be applied selectively. For example, the Leasing mechanism is more likely to be applied to CNG where this business model has already been established in Maryland for supporting these higher cost stations. On-Bill Financing would be relegated to those fuels supported by established regional utilities, namely, CNG and electric utilities, and would require significant State collaboration and agreements with these entities. Similarly, C-PACE may be limited in its applicability for deployment Statewide as not all property owners may want this type of assignment to their property values. ESCOs, while interesting and worth considering in the future, will be difficult to implement in terms of mutually beneficial terms both for station owners and ESCOs.

Finally, QECBs can offer significant advantages as a financial mechanism in terms of their Federal funds leveraging, but there are limitations on how on how these funds can applied and they a typically administered at the County level in Maryland. The administration costs per dollar of QCEB project funding are typically high, and there may be restrictions on QECB funds being applied to the commercial sector. QCEBs may be effective in funding stations for critical regions of the State (e.g., interstate rest stops) on government-owned properties to support emerging AFV growth like EVs. For these cases, however, questions remain on how QCEB proceeds will be administered and by whom, funding level allocations for stations relative to other types of energy projects, and funded-station ownership and operation.

Table 14. Evaluation Results of Potential Financial Mechanisms for Maryland Alternative Fuel Refueling/Recharging Infrastructure

Type of Financial Mechanism	Ease of Implementation in 2-Yr Timeframe	Applies to Multiple Fuels	Statewide Infrastructure Growth Potential	Addresses Multiple Top 5 Barriers	Lower Capital Investment Requirements	Lower Risk Requirements	Leverages External Investment	Flexibility in Application and Process
Direct Loans	**Y**	**Y**	O – EVs only	**Y**	N	N	N	**Y**
Credit Enhancements								
Loan Loss Reserve	Y	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
Interest Rate Buydown	Y	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
Loan Guarantees	Y	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
Loan Insurance	Y	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
Debt Service Reserve Funds	Y	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
Grants	**Y**	**Y**	O – EVs only	**Y**	N	N	**Y**	**Y**
Rebates	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
Off-Balance Sheet Financing								
Leases	N	**Y**	O – CNG only	N	**Y**	**Y**	**Y**	**Y**
On-Bill Financing	N	O – CNG/EVs only	N	N	**Y**	**Y**	**Y**	N
C-PACE	N	**Y**	N	**Y**	**Y**	**Y**	**Y**	**Y**
ESCO	N	**Y**	N	N	**Y**	**Y**	**Y**	N
Qualified Energy Conservation Bonds	N	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	N

Proposed Loan Loss Reserve Pilot Program

Overview and Goals of Pilot Program

Following the evaluation of the types of MEA-sponsored financing mechanisms for supporting alternative fuel refueling infrastructure implementation noted above in Section IV of this report and subsequent discussions with MEA, a Loan Loss Reserve (LLR) Program was selected as the financing mechanism for a proposed pilot program. A LLR program is a type of credit enhancement that is commonly used by state and local governments to reduce some of the risk to private investment in a specified loan program. The LLR is a specific amount of funding from the government sponsor to cover loan principal losses from the program in the case of loan defaults. LLRs are broadly applied to various types of residential and commercial loan programs and have been widely applied to energy projects, including alternative fuel refueling stations. The primary goals of an LLR program are to leverage private investment funding support in new programs that would otherwise be limited, allow for potentially broader underwriting criteria and longer loan tenors by financial institutions supporting the LLR loan program, and reduce loan interest rates in relation to the lower risk enabled by the LLR funds.

The proposed LLR Pilot Program presented below would establish a LLR fund for supporting private sector investment through direct loans to prospective private access alternative fuel refueling station owners statewide. The loans under the LLR program would be made available for the primary alternative fuels used in Maryland today: CNG, E85, electricity, and LPG. As conceived, the LLR Pilot Program would only provide loans for capital design and construction of the stations.

Eligible Alternative Fuel Refueling Station Types and Costs

Each type of alternative fuel refueling station covered by the proposed LLR Pilot Program has unique characteristics and capital costs as related to establishing a station location. This section presents capital cost information for each station type as a means of projecting future average capital loan amounts that will be covered under the LLR program. Cost information for each station type is presented as cost ranges for the variety of configurations, layout, and equipment that may be implemented by typical private access fleets and workplaces in Maryland.

CNG Stations

There are two basic types of CNG vehicle refueling stations: time-fill and fast-fill. Time-fill configurations generally takes several hours (usually conducive to overnight timeframes), whereas fast-fill configurations allow the user to fill CNG vehicles in the same amount of time it

would take to refuel a typical conventional gasoline vehicle. Both of these CNG filling options have their own distinct characteristics and advantages depending on fleet requirements.

Time-fill stations are very useful for fleets that have a regular daily routes and return to a central fleet location each day. In these cases, CNG time-fill refueling can be accomplished overnight. As illustrated in Figure 2[1], time-fill stations are comprised of a natural gas compressor to provide high pressure (typically 3,000-4,000 psi) CNG from the standard low pressure natural gas pipeline source, and single- or dual-port fill posts that have quick disconnect fuel nozzles for attaching to the CNG vehicles. The fill posts are usually manifolded together and aligned with fleet parking areas to facilitate the overnight refueling process.

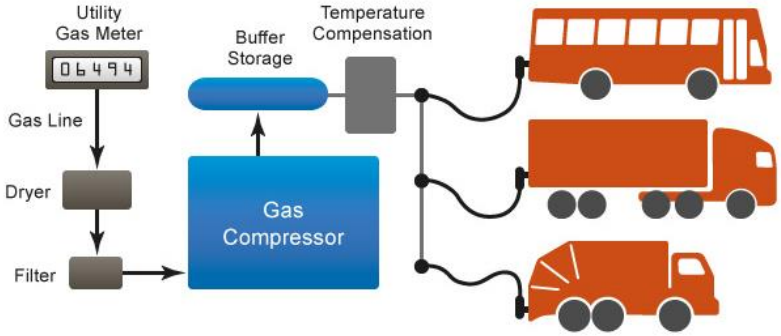

Figure 2. Typical CNG Time-Fill Station Configuration

Some typical CNG fleet examples for various time-fill station capacities are as follows:

- A 20-40 gasoline gallon equivalent (GGE)/day station can support 2 heavy duty vehicles at 20gge per night or 4 medium duty vehicles at 10 GGE per night.
- A 100-200 GGE/day station can support 5-10 heavy duty vehicles at 20 GGE per night or 10-20 medium duty vehicles at 10 GGE per night.
- A 500-800 GGE/day station can support 25-40 heavy duty vehicles at 20 GGE per night or 50-80 medium duty vehicles at 10 GGE per night.

Average costs for these time-fill station applications are provided in Table 15.

CNG fast-fill stations, conversely, are set up to provide much faster fuel delivery than time-fill stations. For these systems (shown in Figure 3[2]), a compressor fills a storage tank(s) with high pressure CNG fuel. Through a control system, the CNG is delivered from the storage tanks to the vehicles on-demand through a fill post or a conventional dispenser. If the CNG storage tank levels become depleted when refueling several vehicles, the compressor will fill the vehicles directly. The sizing of the compressor and affiliated storage needs to be matched to fleet fuel demand for most cost-effective operation.

[1] U.S. Department of Energy's Alternative Fuels Data Center website, http://www.afdc.energy.gov.
[2] U.S. Department of Energy's Alternative Fuels Data Center website, http://www.afdc.energy.gov.

Table 15. Typical Time-Fill Station Costs

Time-Fill CNG Station Type	Low Cost	High Cost	Cost Assumptions
20-40 GGE/day	$35,000	$50,000	•One 8-scfm (4 GGE/hr) compressor • Two dual-hose posts
100-200 GGE/day	$250,000	$500,000	• One 20-50 scfm (10–24 GGE/hr) compressor • 10 dual-hose posts • One time-fill panel; 10-hour fueling window • Included installation costs are estimated at 65% of equipment costs
500-800 GGE/day	$550,000	$850,000	• One 100–175 scfm (48–83 GGE/hr) compressor • 10–40 dual-hose posts • One time-fill panel; 10-hour fueling window • Included installation costs are estimated at 65% of equipment costs

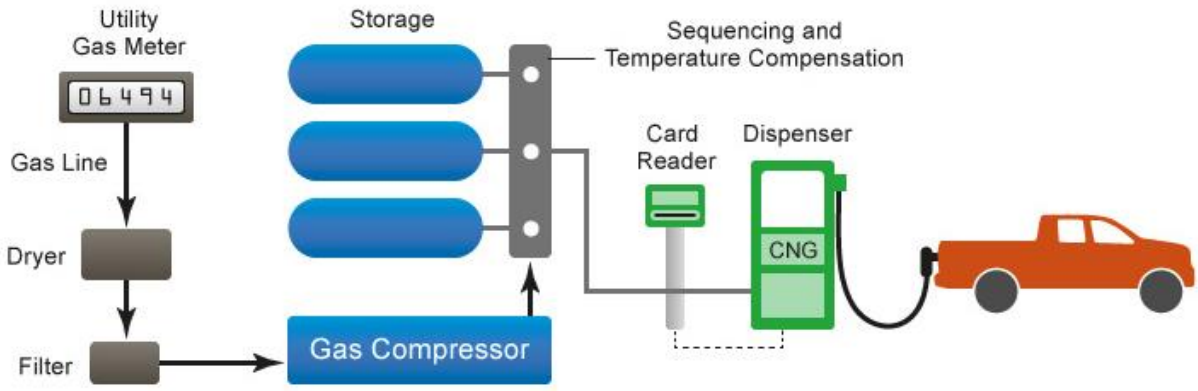

Figure 3. Typical CNG Fast-Fill Station Configuration

Typical fleet examples for CNG fast- fill stations are as follows:

- A station that outputs 20-40 GGE/day is a small station and can support up to four light duty vehicles.
- A station that outputs 100-200 GGE/day is a mid-size time fill station and can support 15-25 light duty vehicles at 7 GGE per day or 9-16 medium duty vehicles at 12 GGE per day.
- A station that outputs 500-800 GGE/day is a large time fill station and can support 50-80 light/medium duty vehicles at 10 GGE per night or 45-65 medium duty vehicles at 12 GGE per night.
- A station that outputs 1,500-2,000 GGE/day is a very large fast fill station, most likely to serve a large volume of heavy fuel use vehicles, like transit buses.

Average costs for CNG fast-fill station applications are provided in Table 16.

Table 16. Typical Fast-fill Station Costs

Fast-Fill CNG Station Type	Low Cost	High Cost	Cost Assumptions
20-40 GGE/day	$45,000	$75,000	•One 8-scfm (4 GGE/hr) compressor • 3,780 scf storage (30 GGE) • One single-hose dispenser
100-200 GGE/day	$400,000	$600,000	• One 40–75 scfm (19–24 GGE/hr) compressor • 16,250 scf storage (129 GGE) • One single-hose metered dispenser • Included installation costs are estimated at 65% of equipment costs
500-800 GGE/day	$700,000	$900,000	• One 180–300 scfm (86–143 GGE/hr) compressor • 34,000 scf storage (270 GGE) • One dual-hose metered dispenser • Included installation costs are estimated at 65% of equipment costs
1,500 – 2,000 GGE/day	$1,200,000	$1,800,000	•Two 300–400 scfm (143–190 GGE/hr) compressors • 55,000 scf storage (437 GGE) • Two dual-hose metered dispensers • Included installation costs are estimated at 50% of equipment costs

LPG Stations

LPG, while a gaseous fuel under atmospheric conditions, takes on liquid state at low pressures (e.g., 200 psi). It therefore is delivered as a low pressure, liquid fuel for LPG vehicles at about the same refueling rates as typical gasoline refueling dispensers. LPG refueling stations are comprised of a storage tank, dispensing pump, and a refueling dispenser. Larger fleets may require larger or multiple tanks and multiple dispensers. A typical LPG refueling station for a fleet application is shown in Figure 4[3].

Figure 4. Typical Propane Fleet Refueling Station Installation

Typical fleet examples with corresponding LPG stations are as follows:

- A 1,000-gal would support 3 school buses at 16 gal/day or 10 shuttle vans at 20 gal/day or 30 taxis at 7gal per day.

[3] U.S. Department of Energy's Alternative Fuels Data Center website, http://www.afdc.energy.gov.

- A 2,000-gal storage tank would support 20 school buses at 15 gal or 30 shuttle vans at 18 gal/day or 60 taxis at 7 gal/day or 65 delivery vans at 6 gal/day.
- A 12,000-gal tank would support 35 school busses at 14 gal/day, 65 police cruisers at 7 gal/day, or 100 shuttle vans at 20 gal/day.
- An 18,000-gal tank would support 60 school busses at 16 gal/day, 70 shuttle vans at 20 gal/day, or 150 taxis at 10 gal/day.
- A 30,000-gal tank would support 70 shuttle vans at 20 gal/day, 100 delivery vans at 9 gal/day, or 250 school buses at 10 gal/day.

Average costs for LPG station applications are provided in Table 17.

Table17. Typical LPG Station Costs

Propane Station Type	Low cost	High cost
1000-gal Storage Tank, 1 Single Hose Dispenser	$45,000	$60,000
2000-gal Storage with Twin 1000-gal Tanks, 1 Dual Hose Dispenser	$60,000	$70,000
12000-gal Storage Tank, 2 Dual-Hose Dispensers	$120,000	$145,000
18000-gal Storage Tank, 3 Dual-Hose Dispensers	150,000	$220,000
30000-gal Storage Tank, 4 Dual-Hose Dispensers	225,000	$300,000

E85 Stations

Among the alternative fuel types, E85 stations are most similar to conventional gasoline stations. E85 stations are comprised of a storage tank, fuel pump, and dispenser. Both aboveground and underground tanks can be used for E85 stations. E85 vehicle fuel rates are very similar to those for gasoline vehicles, between eight and twelve gallons per minute. Station owners have typically taken one of two tracks in terms of installation: use of a new E85 storage tank and new dispensing equipment, or use of an existing fuel storage tank and dispenser that have been refurbished and made ready for E85 fuel.

Typical costs for E85 station installations are shown in Table 18 for both new tank and tank retrofit options. These figures are based on a 2009 study of 84 E85 refueling station installations by the National Renewable Energy Laboratory (NREL) and were adjusted to current dollars using Bureau of Labor Statistics inflation indices. NREL's study results indicated that E85 station costs varied greatly depending on tank size, dispenser needs, and site excavation and concrete requirements.

E85 Station Type	Cost Estimate
New Tank Adjusted for Inflation	$65,044

Table 18. Typical Costs	Retrofit Tank Adjusted for Inflation	$12,356	E85 Station

Electric Vehicle Recharger Stations

There are three types of electric vehicle charging stations that are predominantly used in the marketplace today that are based on their respective charging rates. These are AC Level 1 Charging, AC Level 2 Charging, and DC Fast Charging. AC Level 1 charging supports charging through 120 V AC plugs. The Level 1 chargers can typically supply 2-5 miles of EV range per hour of charging time[4]. AC Level 2 chargers provide EV charging at 208/240 V at 20-100 amp electrical service. These systems can provide charge rates of 10-20 miles of EV range per charging hour. DC Fast Chargers, as the name implies, provide the fastest vehicle charges and involve an AC to DC conversion off-board the vehicle which enables the fastest charging. These chargers utilize 208/480 V AC three-phase commercial service, and can supply 50-70 miles of EV range in about 20 minutes.

Table 19 provides installed cost information for AC Level 2 chargers based on a 2013 survey conducted by the Electric Power Research Institute (EPRI) for installation locations across the country from 2010 through 2013. The survey covered more than 385 commercial charging sites with a total of 989 charging units. Factors cited by EPRI as impacting Level 2 charger installation costs include electrical service upgrade, need for on-site transformer, and need for excavation. The EPRI survey also indicated that 62% of the Level 2 installations at workplace locations and 75% of commercial fleet locations installed two or less charging units.

Table 20 provides installed cost information for DC Fast Chargers based on recent estimates by the Rocky Mountain Institute. The cost variances indicated in Table 20 relate to site electrical upgrades including the need for an on-site transformer, as well as site installation labor and excavation requirements.

Table 19. Typical Commercial AC Level 2 Charger Installation Costs

Commercial AC Level 2 Charger Installation Costs	Cost per Charge Port	Cost per Charger Unit
Average Cost	$2,841	$3,118
Median Cost	$2,543	$2,670

LLR Program Station Cost Assumptions Summary

[4] U.S. Department of Energy's Alternative Fuels Data Center website, http://www.afdc.energy.gov.

For purposes of the LLR Pilot Program assumptions, average costs for the alternative fuel refueling stations were developed from the cost information presented above for representing typical station costs for individual loans. These average costs, shown in Table 21, were identified as being representative of near-term private access station installations in Maryland.

Table 20. Typical DC Charger Installation Costs

DC Fast Charger Installation Cost Elements	Minimum Cost	Maximum Cost
Charger Hardware	$12,000	$35,000
Materials	$400	$1,000
Labor	$6,600	$18,000
Transformer	$10,000	$25,000
Mobilization	$600	$1,200
Permitting	$50	$200
Total	$29,650	$80,400

Table 21. Average Private Access Alternative Fuel Refueling Station Installation Costs

Private Access Station Type	Average Cost	Assumptions
CNG	$268,000	Typical private access stations likely to be time-fill only, or time-fill with some buffer fast-fill capability for providing less than 200 GGE/day at 3,600psi. Costs range from $35,000 - $500,000.
LPG	$65,000	Typical private access stations likely to have two, 1,000 gallon tanks with dual hose dispenser providing less than 200 GGE/day. Costs range from $60,000 - $70,000.
E85	$30,000	Typical private access stations likely to have one new 5,000 – 10,000 gallon aboveground tank with dual hose dispenser. Costs range from $15,000 - $45,000.
Electric Charger	$8,500	Typical private access station likely to have one or two, dual-port AC Level 2 chargers. Costs range from $5,700 to $11,400.

Proposed MEA LLR Pilot Program Characteristics

The following present the primary characteristics and considerations for the proposed LLR Program.

LLR Contributions and Private Investment Loan Portfolios

LLR programs typically establish an overall loan loss reserve funds for covering an entire portfolio of loans. Research on existing LLR programs covering energy project-related loans indicated that the majority established the LLR level between 5 and 30 percent of the loan portfolio total, but most were between 5 and 10 percent. As an example, a 10 percent LLR on a $50 million loan portfolio equates to $5 million of LLR funding. The LLR should be set based on the expected first default losses of the loan program, but it can be set higher than that level as well depending on negotiations with participating private lending institutions and their requirements. The first losses will be covered up to the limits of the LLR and the risk sharing formula agreed to be MEA and the participating private lending institutions. In establishing the LLR, separate LLR equity accounts will be established for each participating private lending institutions and their associated loan portfolios for alternative fuel refueling station installations.

For the MEA LLR Pilot Program, a 10 percent loss reserve is recommended. This level is consistent with other LLR energy project-related programs and maximizes leverage of the private sector investment to the program. Of course, the established loss reserve level will depend directly on MEA's initial negotiations with the financial institutions participating in the program. The higher the leverage ratio, the less risk protection for the lending institution. While loans for alternative fuel refueling stations are not novel, they are not necessarily commonplace and may be perceived to have higher risk for loan defaults. In addition, the installation of stations in certain parts of the State may be viewed as having higher loan risk. In both of these cases, a higher loss reserve level may have to be negotiated with lending institutions for participation in the program.

Assuming a $1 million loss reserve budget established by MEA, and an agreed upon 10 percent loss reserve with private lending institutions, a total of $10 million of alternative fuel station loans could be enabled through the program. This equates to a 10:1 leverage ratio of LLR to total loan portfolio investments. If as part of the loan program a 20 percent down payment is required, the 10 percent loss reserve would enable a 12.5:1 leverage ratio of LLR to total project portfolio investments.

Financial Institution Participation

A variety of financial partners could participate in the LLR Pilot Program including commercial banks, credit unions, specialized financial institutions, and community development institutions. In order to encourage private lender participation in the LLR-backed loan program for alternative fuel refueling station installations, MEA would make program information available through its website and to the network of private lending institutions already working with and that have previously worked with the State. Additional program announcement information may need to be sent to prospective new financial institutions as necessary to

maintain an active participants list with multiple options for borrowers, especially if there are station locations around the State that become underserved by the program.

For those lending institutions that approach MEA for possible participation in the program, MEA will need to qualify these organizations (if the State is not already working with them) and negotiate acceptable LLR loan program terms. Since each financial institution has unique lending practices, MEA agreements with individual institutions may vary.

The key elements of each private lender agreement will involve the following:

- Alternative Fuel Refueling Station Installation Loan Program – The overall loan program will be defined in terms of MEA's goals and objectives.
- Loan Product – Each agreement will define the standard terms and conditions of the loan products that will be offered through the program.
- Underwriting Guidelines and Criteria – MEA and the lending institution need to agree on mutually acceptable loan underwriting criteria for the loans issued under the program. These criteria will be used by the lender in assessing loan applicants and establishing loan documents. The terms can be subsequently modified under mutual agreement from both parties. In practice, the LLR backing for the loan program should afford several benefits for individual loan terms such as reduced credit worthiness and ability to pay criteria, longer loan tenors, larger unsecured loans, lower borrower down payments, and lower interest rates.
- Escrow Account and Reserve Account – Under the terms of the agreement, an escrow account will be established with lending institution under which MEA will provide funding in relation to the agreed upon loss reserve level as loans are issued. Since early in the development of the loan portfolio associated total escrow account levels will be lower, a graduated escrow funding schedule might be negotiated with the lender to mitigate loss coverage concerns for an early loan default. In addition, the agreement should clearly spell out the requirements for escrow account disbursements to the lender in the event of loan default. Typically, disbursement is tied to loss of loan principal only. Terms will also be defined relative to the actual loan default with the borrower, the amount of loss recovery allowed by the lender, and the timeframe for disbursement once the defined default occurs. Account reinvestments and interest earnings will also be addressed. Escrow account reprogramming or repurposing provisions should also be added and mutually agreed upon to offer program flexibility to changing market conditions over time.
- Reporting and Monitoring – The lender will be required to provide regular reports on its loan portfolio and escrow account as agreed to with MEA, typically quarterly. The reports should cover active and inactive accounts.
- Program Timeframe – The agreement should specify the timeframe for adding loans to the portfolio and for adding funding to the escrow account. The reserve account should remain in place until the entire loan portfolio is retired. However, the balance of the escrow account can adjust as the balance of outstanding loans increases or decreases.

Upon retirement of the entire loan portfolio, the remaining escrow account will be transferred back to the State.

- Program Fees – Agreements should specify whether there will be a fee structure under the program. Typical lender fees have ranged from 1-2 percent of the principal loan amount. The fees can help offset administrative costs associated with the LLR program development and operation (e.g., MEA efforts in announcing the program, negotiating with lenders, supporting eligible applicants, etc.). Fees should be reasonably set as lenders may ultimately pass these costs on to borrowers as part of loan fee structures.
- Loan Assignments – The assignment of rights to the LLR escrow account to future purchasers of the loan portfolio should be negotiated with the lender.

LLR Fund Loss Sharing for Individual Loans

One issue that will require negotiation between MEA and lending institutions is the risk-sharing elements for individual loans under the LLR program will be negotiated between MEA and the private lending institutions that participate in the program. Typically, the loss recovery by private institutions on individual loans under an LLR is between 50-100 percent. That is, if the negotiated loss recovery for a defaulted loan is 75 percent, then the lender will only be able to recover 75 percent of the loan's original principal value from its LLR account. Generally, loss recovery values are set between 80-90 percent. This leaves the lender with some risk if the loan defaults thereby motivating them to ensure high level loan origination and administration procedures. Further, the LLR only covers first loan losses up to the cap level of its LLR account. The lender is responsible for any losses above the LLR account cap, usually referred to as second losses. Therefore, even if the loss recovery is high on individual loans, the lenders will want to keep first losses to a minimum in order to ensure coverage for the remainder of the loan portfolio.

Other LLR Program Considerations

In reviewing various types of LLR programs as part of the development of this report, a number of innovative elements of some of these programs are worth considering:

- Rebates for Borrowers – One LLR program for supporting loans for electric vehicle recharging infrastructure offered a rebate to borrowers for portion of the LLR contribution for the enrolled loan amount. The rebate is paid directly to the borrower from the LLR account by the administrator immediately following the loan retirement. To receive the rebate, borrowers must not have been late on more than one monthly payment over the course of the loan. This is a valuable enticement for borrowers to make regular payments and offers value to station owners in terms of cash flow support for ongoing operations and maintenance.
- Higher LLR Contribution Rates for Economically Disadvantaged Areas/Communities – Some LLR programs offered lenders higher LLR contribution rates in economically disadvantaged areas to encourage more private investment to these areas. This could

be considered for the Pilot Program to encourage lender support for alternative fuel fleet infrastructure loans in less developed areas of the State.

- Variable LLR Contribution Rates Based on Loan Applicant Credit Worthiness – Some LLR program have tied loan applicant's credit scores with LLR Contribution rates for the loan. If an applicant's score is over a preset value, the normal contribution rate is provided to the escrow account. If the score is below the preset value, a higher contribution rate is provided. In this way the LLR mitigates lender concerns about loan defaults for less credit-qualified applicants.
- LLR Programs Including Lines of Credit – As a means of supporting newly established alternative fuel refueling stations, lines of credit for station owners may also be considered in the future for supporting cash flow and ensuring long-term sustainability in covering station operational and maintenance costs.

Proposed LLR Pilot Program Elements

In order to assess the various LLR program elements, an LLR model was developed to assess a variety of scenarios for supporting an alternative fuel refueling station loan program. Model inputs and outputs are provided in Table 22. A Base Scenario was developed for the initial LLR program parameters.

Table 23 lists the individual model scenarios, while Table 24 provides the scenario results from the model. Note the Base scenario assumed an initial LLR Budget of $1 million with 10% going to program administration. This level was assumed to accommodate the wide range of the average station installation costs of Table 21 above ($8,500 for EV charger stations to $268,000 for CNG stations), to provide a reasonable LLR budget level for a statewide program, to gain the interest of prospective private lenders, and to provide a substantial base for ensuring a reasonable number of loans get issued for each of the four types of stations. A 10% total LLR Contribution rate was assumed to be reasonable based on the research on other energy project-related LLR programs and to cover anticipated first losses from station loans. The 10% LLR Contribution rate results in $10 million available for loans and an 11:1 effective State contribution leverage ratio. Assuming a 20 percent down payment is required from borrowers, the resulting total station cost investment is $12.5 million, a 14:1 effective State contribution leverage ratio. It was further assumed under the Base Scenario that the entire LLR budget would be covered by MEA with no contributions from the lenders or the borrowers. An equal total loan dollar allocation was assumed for each of the four types of stations although this will likely not occur in practice. Note that given these assumption, the model predicted a total of 532 private access station loans for the Base Scenario.

Table 22. LLR Model Inputs and Outputs

Inputs	Outputs
Total Loan Loss Reserve Budget ($)	Net LLR for Loan Escrow ($)
Program Administration Allocation (%)	Total Lending Support Level ($)
Total Loan Loss Reserve Target (%)	Total Station Cost Investment Supported ($)
MEA LLR Contribution (%)	
Finanical Institutions LLR Contribution (%)	LLR Leverage Ratio #1 - Total Lending Support $ to Net LLR
Borrowers LLR Contribution (%)	
Additional MEA LLR Contribution (e.g., Disadvantaged Community) (%)	LLR leverage Ratio #2 - Total Station Cost Investment to Net LLR
Share of First Losses Borne by LLR (%)	Borrower Rebate ($)
Share of First Losses Borne by Financial Institutions (%)	Total Loan Portfolio Station Allocation ($)
	CNG
Borrower Loan Down Payment (%)	LPG
	E85
Borrower Rebate (%)	EV Charger
Average Station Loan Amounts ($)	Number of Stations Funded
CNG	CNG
LPG	LPG
E85	E85
EV Charger	EV Charger
Total Loan Portfolio Station Allocation (%)	
CNG	
LPG	
E85	
EV Charger	

Table 23. LLR Model Scenarios

Scenario	Description
Base	Initial Scenario
1	Decreased LLR Budget than Base Scenario
2	Increased LLR Budget than Base Scenario
3	Higher LLR Contribution RateTarget than Base Scenario
4	Increase Average Borrower Down Payment than Base Scenario
5	Additional MEA LLR Contribution for Disadvantaged Communities , Decreased Down payment, and Decreased Portfolio Size
6	Increased Lender and Boorower LLR Borrower Contributions and Borrower Rebate
7	100% Loan Allocation to EV Chargers

Table 24. LLR Model Scenario Results

Scenario	LLR Budget	Net LLR Budget	LLR Target %				Total Supported Loan Portfolio	Loan Down Payment	Total Station Investment	LLR #1	LLR #2
			Total	MEA	Lender	Borrow					
Base	$ 1,000,000	$ 900,000	10.0%	10.0%	0.0%	0.0%	$ 10,000,000	20%	$ 12,500,000	11.1	13.9
1	$ 500,000	$ 450,000	10.0%	10.0%	0.0%	0.0%	$ 5,000,000	20%	$ 6,250,000	11.1	13.9
2	$ 2,000,000	$ 1,800,000	10.0%	10.0%	0.0%	0.0%	$ 20,000,000	20%	$ 25,000,000	11.1	13.9
3	$ 1,000,000	$ 900,000	15.0%	15.0%	0.0%	0.0%	$ 6,666,667	20%	$ 8,333,333	7.4	9.3
4	$ 1,000,000	$ 900,000	10.0%	10.0%	0.0%	0.0%	$ 10,000,000	10%	$ 11,111,111	11.1	12.3
5	$ 500,000	$ 450,000	15.0%	15.0%	0.0%	0.0%	$ 3,333,333	10%	$ 3,703,704	7.4	8.2
6	$ 1,000,000	$ 900,000	10.0%	9.0%	0.5%	0.5%	$ 10,000,000	20%	$ 12,500,000	11.1	13.9
7	$ 1,000,000	$ 900,000	10.0%	10.0%	0.0%	0.0%	$ 10,000,000	20%	$ 12,500,000	11.1	13.9
Recommended	**$ 1,000,000**	**$ 900,000**	**10%**	**9.0%**	**0.5%**	**0.5%**	**$ 10,000,000**	**10%**	**$ 11,111,111**	**11.1**	**12.3**

Scenario	LLR Investment ($)			Borrower Rebate	Loan Allocation %				Number of Resulting Station				
	MEA	Lender	Borrower		CNG	LPG	E85	EV	CNG	LPG	E85	EV	Total
Base	$ 1,000,000	$ -	$ -	$ -	25%	25%	25%	25%	12	48	104	368	532
1	$ 500,000	$ -	$ -	$ -	25%	25%	25%	25%	6	24	52	184	266
2	$ 2,000,000	$ -	$ -	$ -	25%	25%	25%	25%	23	96	208	735	1063
3	$ 1,000,000	$ -	$ -	$ -	25%	25%	25%	25%	8	32	69	245	354
4	$ 1,000,000	$ -	$ -	$ -	25%	25%	25%	25%	10	43	93	327	472
5	$ 500,000	$ -	$ -	$ -	25%	25%	25%	25%	3	14	31	109	157
6	$ 900,000	$ 50,000	$ 50,000	$ 50,000	25%	25%	25%	25%	12	48	104	368	532
7	$ 1,000,000	$ -	$ -	$ -	0%	0%	0%	100%	0	0	0	1471	1471
Recommended	**$ 900,000**	**$ 50,000**	**$ 50,000**	**$ 50,000**	**25%**	**25%**	**25%**	**25%**	**10**	**43**	**93**	**327**	**472**

Based on the LLR model scenario results, the following LLR Pilot Program parameters are recommended:

Recommended LLR Pilot Program Parameters			
Total Loan Loss Reserve Target (%)	**10%**	**$**	**1,000,000**
MEA LLR Contribution (%)	9.0%	$	900,000
Finanical Institutions LLR Contribution (%)	0.5%	$	50,000
Borrowers LLR Contribution (%)	0.5%	$	50,000
Program Administration Allocation (%)	**10%**		
Total Lending Support Level		**$**	**10,000,000**
Share of First Losses Borne by LLR (%)	**90%**		
Share of First Losses Borne by Financial Institutions (%)	**10%**		
Total Station Cost Investment		**$**	**11,111,111**
Borrower Loan Down Payment (%)	**10%**		
Borrower Rebate (%)	**0.5%**	**$**	**50,000**
LLR Ratio #1	**11.1**		
LLR Ratio #2	**12.3**		

As shown in Table 24, the recommended LLR Pilot Program parameters could result in 472 private access station loans assuming an equal funding allocation among the four station types and the full use of the total available loan portfolio of $10 million.

Proposed LLR Pilot Program Loan Characteristics

The following are key elements of the individual loans that will be established under the proposed LLR Pilot Program.

Eligible Borrowers

Any commercial company or corporation, or county or local government fleet operating an alternative fuel vehicle fleet in Maryland will be eligible for a loan. Potential applicants may inquire about the loan program through MEA or directly through the financial institutions.

Eligible Projects

Eligible projects include any installation of a CNG, LPG, E85, or EV charger station for refueling/recharging vehicles. Eligible costs include design, engineering, equipment, hardware, construction, and installation.

Loan Application Procedures

The individual financial institutions will be responsible for the loan application and origination procedures whose general underwriting principles have been established under the LLR program agreements with MEA. This will include credit screening and quality checks, loan terms and conditions, and loan documents.

Loan Sizes

Based on the range of eligible stations that could be covered by loans, a broad range of loan sizes is recommended for the program. Minimum loan size should be $5,000 to cover small EV charger installations, while maximum loan size should be set at $500,000 to cover larger CNG refueling station installations.

Loan Tenors

Loan tenors should be established to offer borrowers reasonable timeframes for loan payback without appreciably impacts cash flow. Research indicated that alternative fuel refueling station loan tenors range from 3 to 15 years depending on the size of the loan. Given the recommended loan sizes involved, it is recommended that loan tenors be set between 3 and 10 years, with most loans being established at 3-7 years, and loans over $100,000 being offered longer terms of 8-10 years.

Interest Rates

Market-based interest rates will be established by the participating financial institutions, however, the final rates should reflect the lower risk afforded by the LLR escrow and any negotiated rate terms established in the agreement with MEA. These terms could include a requirement that the interest rates be based on industry indices such as the U.S. prime rate. Tables 25 lists two loan value examples for varying terms and interest rates.

Table 25. Loan Monthly Payment Examples for Varying Terms and Interest Rates

	$10,000 Loan Monthly Payments				
Term	Annual Interest Rate (%)				
(Yrs)	1	3	4	6	8
3	$ 282	$ 291	$ 295	$ 304	$ 313
5	$ 171	$ 180	$ 184	$ 193	$ 203
7	$ 123	$ 132	$ 137	$ 146	$ 156

	$150,000 Loan Monthly Payments				
Term	Annual Interest Rate (%)				
(Yrs)	1	3	4	6	8
7	$ 1,850	$1,982	$2,050	$2,191	$2,338
8	$ 1,626	$1,759	$1,828	$1,971	$2,121
10	$ 1,314	$1,448	$1,519	$1,665	$1,820

Loan Disbursements

MEA and the participating financial institutions will develop loan disbursement terms as part of the LLR agreement. For small size loans, a single loan disbursement following installation and

acceptance should be utilized. For larger loans, a partial disbursement at the start of construction and/or disbursements in concert with major construction milestones may be in order to be in line with construction industry practices.

Loan Pre-Payments

There should be no loan pre-payment penalties associated with loans.

Bibliography

1. "Alternative Fueling Station Locator." Alternative Fuels Data Center. AFDC, 2014. Web. 18 Nov. 2014. <http://www.afdc.energy.gov/locator/stations/>.
2. “Maryland CNG Stations.” Powered by CNG,2014.Web.18 Nov. 2014 <http://poweredbycng.com/maryland-cng-stations/>
3. "MARYLAND AT A GLANCE." Maryland Population. Maryland.gov, 2014. Web. 18 Nov. 2014. <http://msa.maryland.gov/msa/mdmanual/01glance/html/pop.html>.
4. “Electric Vehicle Infrastructure Plan.” Parsons Brinckerhoff. Prepared for the Maryland Electric Vehicle Infrastructure Council. November 2012.
5. Cregger, Joshua. Financing the Infrastructure to Support Alternative Fuel Vehicles. Chicago: 20th Annual Automotive Outlook Symposium, 2013. Print.
6. "Download Edition 33 - Transportation Energy Data Book." Transportation Energy Data Book. ORNL, 2014. Web. 18 Nov. 2014. <http://cta.ornl.gov/data/download33.shtml>.
7. “2014 Retail Fuels Report.” NACS, 2014. 20 Nov.
8. Center for Climate and Energy Solution. “Alternative Fuel Vehicle & Fueling Infrastructure Deployment Barriers & the Potential Role of Private Sector Financial Solutions” (n.d.): n. pag. U.S. Department of Energy, Apr. 2014. Web. <http://www.afdc.energy.gov/uploads/publication/afv_fueling_infrastructure_deployment_barriers.pdf>.
9. Chargepoint Technical support. Phone Interview. Chargepoint. 29 Oct. 2014
10. Frades, Matt. “A Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects” (2014): n. pag. U.S. Department of Energy, Jan. 2014. Web. <http://www.afdc.energy.gov/uploads/publication/guide_ev_projects.pdf>.
11. Hamilton, Jill, and Susan Susanke. Phone interview. Sustainable Energy Strategies Inc. 30 Oct. 2014
12. Oregon Alternative Fuel Vehicle Infrastructure Working Group. "Report of the Alternative Fuel Vehicle Infrastructure Working Group." (2010): n. pag. Multnomah County Oregon, Jan. 2010. Web. <http://www.psrc.org/assets/3751/W_OregonReport_2010.pdf>.
13. Pennsylvania State University. “Transportation and Fuels”. N.p.: PSU, n.d. Web. < http://www.research.psu.edu/events/expired-events/naturalgas/presentations/FT.pdf>
14. Searle, Stephanie, Francisco P. Sanchez, Chris Malins, and John German. “Technical Barriers to the Consumption of Higher Blends of Ethanol.” Rep. N.p.: International Council on Clean Transportation, 2014. Web. <http://bipartisanpolicy.org/wp-content/uploads/sites/default/files/files/ICCT_Ethanol.pdf>
15. Smith, Margaret, and John Gonzales. "Costs Associated With Compressed Natural Gas Vehicle Fueling Infrastructure." (2014): n. pag. U.S. Department of Energy, Sept. 2014. Web. <http://www.afdc.energy.gov/uploads/publication/cng_infrastructure_costs.pdf>.
16. Smith, Margaret, and John Gonzales. “Costs Associated With Propane Vehicle Fueling” Infrastructure (2014): n. pag. U.S. Department of Energy, Aug.-Sept. 2014. Web. <http://www.afdc.energy.gov/uploads/publication/propane_costs.pdf>.

17. Troilo, Peter. Phone Interview. Mid-Atlantic Petroleum. 11 Nov. 2014
18. Werpy, M. R., D. Santini, A. Burnham, and M. Mintz. “Natural Gas Vehicles: Status, Barriers, and Opportunities”. Rep. N.p.: Energy Systems Division, Argonne National Laboratory, 2010. Web. <http://www.afdc.energy.gov/pdfs/anl_esd_10-4.pdf>
19. Center for Climate and Energy Solution. “Alternative Fuel Vehicle & Fueling Infrastructure Deployment Barriers & the Potential Role of Private Sector Financial Solutions” (n.d.): n. pag. U.S. Department of Energy, Apr. 2014. Web. <http://www.afdc.energy.gov/uploads/publication/afv_fueling_infrastructure_deployment_barriers.pdf>.
20. Center for Climate and Energy Solutions. “Applying the Energy Service Company Model to Advance Deployment of Fleet Natural Gas Vehicles and Fueling Infrastructure”; U.S. Department of Energy, June 2014. Web. <http://www.afdc.energy.gov/uploads/publication/esco_model.pdf>
21. The Cadmus Group. “Blueprint for Building the Energy Economy in Maryland: Green Bank Preliminary Findings Report” Maryland Clean Energy Center, Dec. 1, 2014.
22. Kennan, Hallie. Energy Innovation. “Working Paper: State Green Banks for Clean Energy” Jan. 2014 <http://energyinnovation.org/wp-content/uploads/2014/01/WorkingPaper_StateGreenBanks.pdf>.
23. Lawrence Berkeley National Laboratory. “Using Qualified Energy Conservation Bonds (QECBs) to Fund a Residential Energy Efficiency Loan Program: Case Study on Saint Louis County, MO” June 20, 2011. Web. <http://www.abundantpower.com/Files/Solutions.Qualified.Energy.Conservation.Bonds.Case.Study.pdf>.
24. Center for Climate and Energy Solutions. “The Role of Clean Energy Banks in Increasing Private Investment in Electric Vehicle Charging Infrastructure”; U.S. Department of Energy, November 2014. Web <http://www.c2es.org/docUploads/cebs-and-ev-charging-december-2015.pdf>.
25. Montgomery, Gregory. Phone Interview. Abundant Power. 3 Dec. 2014.
26. O’Neil, Kerry. Phone Interview. Clean Energy Finance and Investment Authority. 24 Nov. 2014.
27. Healey, Ben. Phone Interview. Clean Energy Finance and Investment Authority. 26 Nov. 2014.
28. Cecere, Mike. Phone Interview. Clean Energy Fuels. 3 Dec. 2014.
29. "Energy.gov." Qualified Energy Conservation Bonds. U.S. Department of Energy, n.d. Web. 9 Dec. 2014.
30. Connecticut Green Bank 2013 Annual Report; Clean Energy Finance and Investment Authority <http://www.ctcleanenergy.com/annualreport/>
31. Qualified Energy Conservation Bonds, Energy Programs Consortium, June 2014.
32. U.S. Department of Energy’s Alternative Fuels Data Center website, <http://www.afdc.energy.gov>
33. Moriarty, K., C. Johnson, T. Sears, and P. Bergeron. E85 Dispenser Study. Washington, D.C.: United States. Dept. of Energy, 2009. NREL, Dec. 2009. Web. Feb. 2015.
34. "Inflation Calculator: Bureau of Labor Statistics." U.S. Bureau of Labor Statistics. U.S. Bureau of Labor Statistics, n.d. Web. 23 Feb. 2015. <http://www.bls.gov/data/inflation_calculator.htm>.
35. “Electric Vehicle Supply Equipment Installed Cost Analysis.” Final Report 3002000577. December 2013.

36. “Pulling Back the Veil on EV Charging Station Costs.” Rocky Mountain Institute. RMI Outlet. April 29, 2014.
37. Clean Energy Finance Guide (Chapter 5: Basic Concepts for Clean Energy Unsecured Lending and Loan Loss Reserve Funds), Draft, U.S. Department of Energy, December 9, 2010.

APPENDIX A – Complete Listing of Existing AFV Refueling Station Locations and Contact Information

Fuel Type Code	Station Number	Station Name	Street Address	City	County	State	ZIP	Station Phone	Public or Private Access	level one chargers	level two chargers	level 3 chargers
CNG	1	Clean Energy - BWI Airport - Maryland Department of General Services - Public Access	151 Aviation Dr	Baltimore	Baltimore City	MD	21240	410-459-2834	Public			
CNG	2	Maryland Department of General Services	301 W Preston St	Baltimore	Baltimore City	M.D.	21201		Private			
CNG	3	Clean Energy - BWI Airport - Maryland Department of General Services - Private Access	151 Aviation Dr	Baltimore	Baltimore City	M.D.	21240		Private			
CNG	4	Clean N' Green - Waste Management	5500 Fairfield Rd	Curtis Bay	Baltimore	MD	21226	800-850-5801	Public			
CNG	5	Fort Detrick	101 Hamilton St	Frederick	Frederick	M.D.	21702		Private			
CNG	6	Montgomery County Transit - Planned station	17000 Crabbs Branch Way	Gaithersburg	Montgomery	MD	20855	240-777-5750	Public			
CNG	7	Montgomery County Transit	16650 Crabbs Branch Way	Gaithersburg	Montgomery	MD	20855	240-777-5751	Private			
CNG	8	Department of Commerce	100 Bureau Dr	Gaithersburg	Montgomery	MD	20899		Private			
CNG	9	City of Greenbelt Public Works Department	555 Crescent Rd	Greenbelt	Prince George's	M.D.	20770		Private			
CNG	10	Smithsonian Transportation Repair Shop - Garber Facility	3904 Old Silver Hill Rd	Suitland	Prince George's	M.D.	20746		Private			
E85	11	Shell	811 Bestgate Rd	Annapolis	Anne Arundel	MD	21401	410-266-5882	Public			
E85	12	Citgo	2040 West St	Annapolis	Anne Arundel	MD	21401	410-571-5878	Public			
E85	13	Navy Exchange - Annapolis	101 Kinkaid Rd	Annapolis	Anne Arundel	MD	21402	410-757-5005	Public			
E85	14	A-1 Auto - Three Brothers Car Repair	3001 Frederick Ave	Baltimore	Baltimore City	MD	21223	410-566-5878	Public			
E85	15	Bethesda W Express	8140 River Rd	Bethesda	Montgomery	MD	20816	301-652-4440	Public			
E85	16	Frederickinsane W Express	1500 W Patrick St	Frederick	Frederick	MD	21702	301-694-0077	Public			
E85	17	Washingtonian W Express	10003 Fields Rd	Gaithersburg	Montgomery	MD	20878	301-840-0077	Public			
E85	18	Gaithersburg W Express	100 N Frederick Ave	Gaithersburg	Montgomery	MD	20877	301-990-6814	Public			
E85	19	Germantown W Express	20010 Frederick Rd	Germantown	Montgomery	MD	20876	301-353-6266	Public			
E85	20	Fox Chapel Sunoco	19039 Frederick Rd	Germantown	Montgomery	MD	20876	301-540-0547	Public			
E85	21	Towncenter W Express	12901 Middlebrook Rd	Germantown	Montgomery	MD	20874	301-972-3101	Public			
E85	22	Fort Meade Auto Center	3240 Fort Meade Rd	Laurel	Prince George's	MD	20724	301-490-6800	Public			
E85	23	Potomac Sunoco	11355 Seven Locks Rd	Potomac	Montgomery	MD	20854	301-299-0000	Public			
E85	24	North Potomac Sunoco	13010 Darnestown Rd	Rockville	Montgomery	MD	20850	301-424-8885	Public			
E85	25	Takoma Park W Express	8400 New Hampshire Ave	Takoma Park	Montgomery	MD	20912	301-270-7110	Public			
ELEC	26	Olde Towne Youth Center - Gaithersburg	301 Teachers Way	Gaithersburg	Montgomery	MD	20877	301-258-6374	Public	3		
ELEC	27	Darcars Nissan	15811 Indianola Dr	Rockville	Montgomery	MD	20855	301-309-2300	Public		1	
ELEC	28	Academy Ford	15601 Baltimore Ave	Laurel	Prince George's	MD	20707	301-419-2700	Public		2	
ELEC	29	Passport Nissan Marlow Heights	4705 Auth Way	Marlow Heights	Prince George's	MD	20748	301-423-8400	Public		1	
ELEC	30	Darcars Nissan - College Park	9500 Baltimore Ave	College Park	Prince George's	MD	20740	301-441-8000	Public		1	
ELEC	31	Tischer Nissan	9810 Ft Meade Rd	Laurel	Prince George's	MD	20724	301-498-5522	Public		1	
ELEC	32	Chevy Chase Nissan	7701 Wisconsin Ave	Bethesda	Montgomery	MD	20814	301-654-8300	Public		1	
ELEC	33	Frederick Nissan	7416 Grove Rd	Frederick	Frederick	MD	21704	301-662-2111	Public		1	
ELEC	34	The Frederick Motor Company	1 Waverley Dr	Frederick	Frederick	MD	21702	301-663-8111	Public		2	
ELEC	35	Criswell Nissan	19874 Amaranth Dr	Germantown	Montgomery	MD	20874	301-670-5800	Public		1	
ELEC	36	Nissan of Bowie	2500 N Crain Hwy	Bowie	Prince George's	MD	20716	301-731-4400	Public		1	
ELEC	37	Hamilton Nissan	1808 Dual Hwy	Hagerstown	Washington	MD	21740	301-733-7222	Public		1	
ELEC	38	Waldorf Ford	2440 Crain Hwy	Waldorf	Charles	MD	20601	301-843-2400	Public		1	
ELEC	39	Sheehy Nissan - Waldorf	2850 Crain Hwy	Waldorf	Charles	MD	20601	301-843-5500	Public		1	
ELEC	40	Herb Gordon Nissan	3131 Automobile Blvd	Silver Spring	Montgomery	MD	20904	301-890-6200	Public		1	
ELEC	41	Bob Bell Nissan	7900 Eastern Ave	Baltimore	Baltimore City	MD	21224	410-288-2900	Public		1	
ELEC	42	Annapolis Friends Meeting	351 Dubois Ave	Annapolis	Anne Arundel	MD	21401	410-263-6417	Public	2		
ELEC	43	Old Farm Court Charger	116 Old Farm Ct	Glen Burnie	Prince George's	MD	21060	410-263-6417	Public	2		
ELEC	44	Antwerpen Nissan	1701 Woodlawn Dr	Baltimore	Baltimore City	MD	21207	410-298-4400	Public		1	
ELEC	45	McHenry Row	1750 Whetstone Way	Baltimore	Baltimore City	MD	21230	410-545-7660	Public		2	
ELEC	46	Len Stoler Nissan	11408 Reisterstown Rd	Owings Mills	Baltimore	MD	21117	410-356-7000	Public		1	
ELEC	47	Norris Nissan West	8900 Baltimore National Pike	Ellicott City	Howard	MD	21043	410-465-5550	Public		1	
ELEC	48	Autoflex Fleet Services	1206 Ridgely St	Baltimore	Baltimore City	MD	21230	410-625-3180	Public		2	
ELEC	49	Antwerpen Nissan - Clarksville	12491 Auto Dr	Clarksville	Howard	MD	21029	410-531-5700	Public		1	
ELEC	50	Nationwide Motor Sales Corp	2085 York Rd	Timonium	Baltimore	MD	21093	410-646-4700	Public		1	
ELEC	51	Pohanka Nissan - Salisbury	2012 N Salisbury Blvd	Salisbury	Wicomico	MD	21801	410-546-4700	Public		1	
ELEC	52	Bob Davidson Ford Lincoln	1845 E Joppa Rd	Baltimore	Baltimore City	MD	21234	410-661-6400	Public		1	
ELEC	53	Bob Davidson Ford Lincoln	1845 E Joppa Rd	Parkville	Baltimore	MD	21234	410-661-6400	Public		1	
ELEC	54	Sheehy Nissan	7232 Ritchie Hwy	Glen Burnie	Prince George's	MD	21061	410-760-5800	Public		1	
ELEC	55	Baltimore Washington Medical Center	300 Hospital Dr	Glen Burnie	Prince George's	MD	21061	410-787-4411	Public	4		
ELEC	56	Bel Air Nissan	1508 Bel Air Rd	Bel Air	Harford	MD	21014	410-879-1101	Public		1	
ELEC	57	CarMax Nissan - White Marsh	10101 Philadelphia Rd	White Marsh	Baltimore	MD	21162	410-931-4900	Public		1	
ELEC	58	City of Baltimore - War Memorial Plaza	400 E Lexington St	Baltimore	Baltimore City	MD	21202	443-573-2800	Public		2	
ELEC	59	Municipal Garage	200 N Holliday St	Baltimore	Baltimore City	MD	21202	443-573-2800	Public		1	
ELEC	60	Community College of Baltimore County (CCBC)	800 S Rolling	Catonsville	Baltimore	MD	21228	443-840-2222	Public		2	
ELEC	61	Bob Bell Ford	7125 Ritchie Hwy	Glen Burnie	Prince George's	MD	21061	800-824-6303	Public		1	
ELEC	62	11200 Rockville Pike	11200 Rockville Pike	Rockville	Montgomery	MD	20852	800-663-5633	Public		4	
ELEC	63	1801 Rockville Pike	1801 Rockville Pike	Rockville	Montgomery	MD	20852	800-663-5633	Public		1	
ELEC	64	702 King Farm	702 King Farm Blvd.	Rockville	Montgomery	MD	20850	800-663-5633	Public		1	
ELEC	65	805 King Farm	805 King Farm Blvd.	Rockville	Montgomery	MD	20850	800-663-5633	Public		1	
ELEC	66	Ashland Garage	200 N Washington St	Baltimore	Baltimore City	MD	21231	800-663-5633	Public		1	
ELEC	67	BAEF	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		4	
ELEC	68	BGE Lord Baltimore Building	2800 Lord Baltimore Dr.	Baltimore	Baltimore City	MD	21244	800-663-5633	Public		2	
ELEC	69	Blair Shopping Center	1290 East West Highway	Silver Spring	Montgomery	MD	20910	800-663-5633	Public		2	
ELEC	70	Blairs	8201 16th St.	Silver Spring	Montgomery	MD	20910	800-663-5633	Public		1	
ELEC	71	Building F	7300 E Sundown Ct	Frederick	Frederick	MD	21702	800-663-5633	Public		2	
ELEC	72	BWI Airport - Daily Ground Floor	7062 Elm Road	Baltimore	Baltimore City	MD	21240	800-663-5633	Public		4	
ELEC	73	BWI Airport - Daily Rooftop	7062 Elm Road	Baltimore	Baltimore City	MD	21240	800-663-5633	Public		2	
ELEC	74	BWI Airport - Hourly Ground Floor	7062 Elm Road	Baltimore	Baltimore City	MD	21240	800-663-5633	Public		4	
ELEC	75	Chesapeake Building	3115 Chesapeake Building	College Park	Prince George's	MD	20742	800-663-5633	Public		1	
ELEC	76	Comfort Inn Shady Grove	16216 Frederick Road	Gaithersburg	Montgomery	MD	20877	800-663-5633	Public		2	
ELEC	77	CRRA	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	78	FTMA	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	79	FABM	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	80	FRAT	4061 Telsa Drive Suite A	Bowie	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	81	Harbor East	650 S. Exeter St	Baltimore	Baltimore City	MD	21202	800-663-5633	Public		1	
ELEC	82	Hilton Garden Inn Waldorf	10385 O'Donnell Pl.	Waldorf	Charles	MD	20603	800-663-5633	Public		2	
ELEC	83	Howard County Government - Dorsey Building	9250 Bendix Rd.	Columbia	Howard	MD	21045	800-663-5633	Public		8	
ELEC	84	Johns Hopkins - Bayview	Mason F. Lord Center Tower 5200 Eastern Avenue	Baltimore	Baltimore City	MD	21224	800-663-5633	Public		14	
ELEC	85	Johns Hopkins University	3101 Wyman Park Dr	Baltimore	Baltimore City	MD	21211	800-663-5633	Public		8	
ELEC	86	Knighton Garage	1-A Colonial Avenue	Annapolis	Anne Arundel	MD	21401	800-663-5633	Public		2	
ELEC	87	LAAD	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	88	Legg Mason Building	100 International Dr	Baltimore	Baltimore City	MD	21202	800-663-5633	Public		2	
ELEC	89	Linganore Winery	13601 Glissans Mill Road	Mount Airy	Carroll	MD	21771	800-663-5633	Public		2	
ELEC	90	MACH	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	91	Maple Lawn	8180 Maple Lawn Blvd	Fulton	Howard	MD	20759	800-663-5633	Public		4	
ELEC	92	Maryland Dept. of Transportation Corporate Headquarters	7201 Corporate Dr.	Hanover	Anne Arundel	MD	21076	800-663-5633	Public		2	
ELEC	93	MOMs Organic Market Rockville	5566 Randolph Rd	Rockville	Montgomery	MD	20852	800-663-5633	Public		2	
ELEC	94	MOMs Organic Market Waldorf	3501 Plaza Way	Waldorf	Charles	MD	20603	800-663-5633	Public		2	
ELEC	95	Mount Washington Campus	5601 Smith Avenue Suite 1100	Baltimore	Baltimore City	MD	21209	800-663-5633	Public		7	
ELEC	96	Nexus	1000 Island Professional Park	Stevensville	Queen Anne's	MD	21666	800-663-5633	Public		2	
ELEC	97	One South Street	One South Street Suite 820	Baltimore	Baltimore City	MD	21202	800-663-5633	Public		1	
ELEC	98	PABS	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	99	PAST	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	100	Patapsco Building	7501 Paint Branch Parkway	College Park	Prince George's	MD	20742	800-663-5633	Public		2	
ELEC	101	PBLL	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	102	Perdue East	1101 Camden Ave.	Salisbury	Wicomico	MD	21801	800-663-5633	Public		2	
ELEC	103	Perdue North	1101 Camden Ave.	Salisbury	Wicomico	MD	21801	800-663-5633	Public		2	
ELEC	104	Potomac Place Shopping Center	10132 River Road	Potomac	Montgomery	MD	20854	800-663-5633	Public		1	
ELEC	105	President Street Parking Garage	820 S. President Street	Baltimore	Baltimore City	MD	21202	800-663-5633	Public		1	
ELEC	106	RCF	4061 Telsa Drive Suite A	BOWIE	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	107	SemaConnect UL HQ	4061 Telsa Dr	Bowie	Prince George's	MD	20715	800-663-5633	Public		6	
ELEC	108	Severn Building	5245 Greenbelt Road	College Park	Prince George's	MD	20740	800-663-5633	Public		1	
ELEC	109	SHA - Hartford County	1400 Belcamp Road	Belcamp	Harford	MD	21017	800-663-5633	Public		1	
ELEC	110	SMIT	4061 Telsa Drive Suite A	Bowie	Prince George's	MD	20715	800-663-5633	Public		1	
ELEC	111	Spinnaker Garage	707 President St	Baltimore	Baltimore City	MD	21202	800-663-5633	Public		1	
ELEC	112	Springhill Suites Annapolis	189 Admiral Cochrane Drive	Annapolis	Anne Arundel	MD	21401	800-663-5633	Public		1	
ELEC	113	St. Johns Properties	2560 Lord Baltimore Drive	Baltimore	Baltimore City	MD	21244	800-663-5633	Public		2	
ELEC	114	Sun Trust Bank	10418 Old Georgetown Rd	Bethesda	Montgomery	MD	20814	800-663-5633	Public		2	
ELEC	115	The Fitzgerald Parking Garage	1201 West Mt. Royal Ave.	Baltimore	Baltimore City	MD	21217	800-663-5633	Public		2	
ELEC	116	Tower 1 Building	1101 Wootton Parkway	Rockville	Montgomery	MD	20852	800-663-5633	Public		2	
ELEC	117	Tower 2	2000 Tower Oaks Blvd	Rockville	Montgomery	MD	20852	800-663-5633	Public		1	
ELEC	118	Turner Hall Visitor Center	1201 Turner Hall	College Park	Prince George's	MD	20742	800-663-5633	Public		1	
ELEC	119	UMBC - Stadium Lot	Stadium Lot behind Warehouse Hilltop Circle & Poplar Ave	Baltimore	Baltimore City	MD	21250	800-663-5633	Public		2	

ELEC	120	Union Wharf	915 S. Wolfe Street	Baltimore	Baltimore City	MD	21231	800-663-5633	Public		1	
ELEC	121	Walgreens - Abingdon, MD #7537	3409 Emmorton Rd	Abingdon	Harford	MD	21009	800-663-5633	Public		1	
ELEC	122	Walgreens - Baltimore, MD #10078	2560 Quarry Lake Drive	Baltimore	Baltimore City	MD	21209	800-663-5633	Public		1	
ELEC	123	Walgreens - Baltimore, MD #9331	4050 Liberty Rd	Baltimore	Baltimore City	MD	21244	800-663-5633	Public		1	
ELEC	124	Walgreens - Baltimore, MD #9770	5458 Harford Road	Baltimore	Baltimore City	MD	21214	800-663-5633	Public		1	
ELEC	125	Walgreens - Bel Air, MD #11898	1827 Emmorton Rd	Bel Air	Harford	MD	21015	800-663-5633	Public		1	
ELEC	126	Walgreens - Bel Air, MD #12433	588 Market Place Drive	Bel Air	Harford	MD	21014	800-663-5633	Public		1	
ELEC	127	Walgreens - Bel Air, MD #12748	1201 East Churchville Rd	Bel Air	Harford	MD	21014	800-663-5633	Public		1	
ELEC	128	Walgreens - Brooklyn Park, MD #6037	5740 Ritchie Highway	Brooklyn Park	Anne Arundel	MD	21225	800-663-5633	Public		2	
ELEC	129	Walgreens - Catonsville, MD #12790	6505 Baltimore National Pike	Catonsville	Baltimore	MD	21228	800-663-5633	Public		1	
ELEC	130	Walgreens - Catonsville, MD #7571	5857 Baltimore National Pike	Catonsville	Baltimore	MD	21228	800-663-5633	Public		1	
ELEC	131	Walgreens - Clarksville, MD #10830	12400 Auto Drive	Clarksville	Howard	MD	21029	800-663-5633	Public		1	
ELEC	132	Walgreens - Columbia, MD #13640	5585 Twin Knolls Rd	Columbia	Howard	MD	21045	800-663-5633	Public		1	
ELEC	133	Walgreens - Edgewood, MD #6563	1850 Pulaski Highway	Edgewood	Harford	MD	21040	800-663-5633	Public		1	
ELEC	134	Walgreens - Eldersburg, MD #7674	1260 Liberty Rd	Eldersburg	Carroll	MD	21784	800-663-5633	Public		1	
ELEC	135	Walgreens - Forest Hill, MD #9606	2016 Rock Spring Road	Forest Hill	Harford	MD	21050	800-663-5633	Public		1	
ELEC	136	Walgreens - Glen Burnie, MD #7594	7901 Ritchie Highway	Glen Burnie	Prince George's	MD	21061	800-663-5633	Public		1	
ELEC	137	Walgreens - Glen Burnie, MD #7701	7983 Crain Highway S	Glen Burnie	Prince George's	MD	21061	800-663-5633	Public		1	
ELEC	138	Walgreens - Glen Burnie, MD #9008	6700 Ritchie Highway	Glen Burnie	Prince George's	MD	21061	800-663-5633	Public		1	
ELEC	139	Walgreens - La Plata, MD #10083	6500 Crane Highway	La Plata	Charles	MD	20646	800-663-5633	Public		1	
ELEC	140	Walgreens - Lusby, MD #10403	11745 Rousby Hall Rd	Lusby	Calvert	MD	20657	800-663-5633	Public		1	
ELEC	141	Walgreens - Lutherville, MD #12647	1801 York Road	Lutherville	Baltimore	MD	21093	800-663-5633	Public		1	
ELEC	142	Walgreens - Randallstown, MD #9249	9110 Liberty Rd	Randallstown	Baltimore	MD	21133	800-663-5633	Public		1	
ELEC	143	Walgreens - Waldorf, MD #9083	25 High Street	Waldorf	Charles	MD	20602	800-663-5633	Public		1	
ELEC	144	Washington Blvd	9711 Washingtonian Boulevard	Gaithersburg	Montgomery	MD	20878	800-663-5633	Public		1	
ELEC	145	Win Kelly Dealership	12421 Auto Drive	Clarksville	Howard	MD	21029	800-663-5633	Public		2	
ELEC	146	Apple Ford Lincoln	8800 Stanford Blvd	Columbia	Howard	MD	21045	888-850-2785	Public		4	
ELEC	147	NRG eVgo - Arundel Mills Mall	7000 Arundel Mills Cir	Hanover	Anne Arundel	MD	21076	877-455-3833	Public		1	1
ELEC	148	NRG eVgo - Bowie Town Center	15607 [illegible] Dr	Bowie	Prince George's	MD	20716	877-455-3833	Public		1	1
ELEC	149	NRG eVgo - FedEx Field Convenience Station	1600 FedEx Way	Landover	Prince George's	MD	20785	877-455-3833	Public	10	10	
ELEC	150	NRG eVgo - Queenstown Premium Outlets	441 Outlet Center Dr	Queenstown	Queen Anne's	MD	21658	877-455-3833	Public	1	1	1
ELEC	151	NRG eVgo - St. Charles Towne Center	11110 Mall Cir	Waldorf	Charles	MD	20603	877-455-3833	Public	1	1	1
ELEC	152	NRG eVgo - Walgreens Freedom Station	950 York Rd	Towson	Baltimore	MD	21204	877-455-3833	Public	1	1	1
ELEC	153	NRG eVgo - Woodley Gardens Freedom Station	1101 Nelson St	Rockville	Montgomery	MD	20850	877-455-3833	Public	1	1	1
ELEC	154	Hagerstown Premium Outlets - Tesla	495 Prime Outlets Blvd	Hagerstown	Washington	MD	21740	877-798-3752	Public			8
ELEC	155	Westfield Montgomery Mall - Tesla	7101 Democracy Blvd	Bethesda	Montgomery	MD	20817	877-798-3752	Public			3
ELEC	156	Century Ford	500 Century Dr	Mount Airy	Carroll	MD	21771	888-513-2882	Public		1	
ELEC	157	DARCARS Ford Kia	9026 Lanham Severn Rd	Lanham	Prince George's	MD	20706	888-832-9773	Public		1	
ELEC	158	[illegible]	3801 Liberty Heights Ave	Baltimore	Baltimore City	MD	21215	888-758-4389	Public		1	
ELEC	159	[illegible]	4050 Eastern Ave	Baltimore	Baltimore City	MD	21224	888-758-4389	Public		1	
ELEC	160	[illegible]	6501 York Rd	Baltimore	Baltimore City	MD	21212	888-758-4389	Public		1	
ELEC	161	[illegible]	1500 E North Ave	Baltimore	Baltimore City	MD	21213	888-758-4389	Public		1	
ELEC	162	[illegible]	9401 Belair Rd	Perry Hall	Baltimore	MD	21128	888-758-4389	Public		1	
ELEC	163	[illegible]	8008 Philadelphia Rd	Rosedale	Baltimore	MD	21237	888-758-4389	Public		1	
ELEC	164	[illegible]	2204 N Rolling Rd	Woodlawn	Baltimore	MD	21244	888-758-4389	Public		1	
ELEC	165	ABERDEEN	Raritan Ave	Aberdeen Proving Ground	Harford	MD	21005	888-758-4389	Public		4	
ELEC	166	AP HOTEL GARAGE	7795 Arundel Mills Blvd	Hanover	Anne Arundel	MD	21076	888-758-4389	Public		4	
ELEC	167	ARUNDEL MILLS	7503 Teague Rd	Hanover	Anne Arundel	MD	21076	888-758-4389	Public	1		
ELEC	168	BALTCO REV AUTH	110 W Susquehanna Ave	Towson	Baltimore	MD	21204	888-758-4389	Public	2	2	
ELEC	169	BALTCO REV AUTH	100 W Susquehanna Ave	Towson	Baltimore	MD	21204	888-758-4389	Public	2	2	
ELEC	170	BALTCO REV AUTH	118 Towsontowne Blvd W	Towson	Baltimore	MD	21204	888-758-4389	Public	2	2	
ELEC	171	BALTCO REV AUTH	108 Ware Ave	Towson	Baltimore	MD	21204	888-758-4389	Public	2	2	
ELEC	172	BALTCO REV AUTH	5 E Pennsylvania Ave	Towson	Baltimore	MD	21286	888-758-4389	Public	2	2	
ELEC	173	BALTIMORE CITY	408 S Caroline St	Baltimore	Baltimore City	MD	21231	888-758-4389	Public	1	1	
ELEC	174	BALTIMORE CITY	Water St	Baltimore	Baltimore City	MD	21202	888-758-4389	Public	1	1	
ELEC	175	BALTIMORE CITY	600 W Lexington St	Baltimore	Baltimore City	MD	21201	888-758-4389	Public	2	2	
ELEC	176	BALTIMORE CITY	111 S Eutaw St	Baltimore	Baltimore City	MD	21201	888-758-4389	Public	1	1	
ELEC	177	BALTIMORE CITY	510 E Lexington St	Baltimore	Baltimore City	MD	21202	888-758-4389	Public	1	1	
ELEC	178	BALTIMORE CITY	1511 N Charles St	Baltimore	Baltimore City	MD	21201	888-758-4389	Public	1	1	
ELEC	179	BALTIMORE CITY	600 E Central Ave	Baltimore	Baltimore City	MD	21202	888-758-4389	Public	1	1	
ELEC	180	BALTIMORE CITY	40 E West St	Baltimore	Baltimore City	MD	21230	888-758-4389	Public	1	1	
ELEC	181	BALTIMORE CITY	15 Guilford Ave	Baltimore	Baltimore City	MD	21202	888-758-4389	Public	1	1	
ELEC	182	BALTIMORE CITY	300 W Lombard St	Baltimore	Baltimore City	MD	21201	888-758-4389	Public	1	1	
ELEC	183	BMW ANNAPOLIS	14 Old Mill Bottom Rd	Annapolis	Anne Arundel	MD	21409	888-758-4389	Public		2	
ELEC	184	BMW CATONSVILLE	6700 Baltimore National Pike	Baltimore	Baltimore City	MD	21228	888-758-4389	Public		2	
ELEC	185	BMW TOWSON	700 Kenilworth Dr	Towson	Baltimore	MD	21204	888-758-4389	Public		2	
ELEC	186	CAPITAL COMPLEX	28 St Johns St	Annapolis	Anne Arundel	MD	21401	888-758-4389	Public	1	1	
ELEC	187	CARCHARGING	4950 Elm St	Bethesda	Montgomery	MD	20814	888-758-4389	Public		1	
ELEC	188	CARCHARGING	335 Hungerford Dr	Rockville	Montgomery	MD	20850	888-758-4389	Public		1	
ELEC	189	CARCHARGING	14955 Shady Grove Rd	Rockville	Montgomery	MD	20850	888-758-4389	Public		1	
ELEC	190	CBC	114 Fremont St	St. Michaels	Talbot	MD	21663	888-758-4389	Public		2	
ELEC	191	CENSUS	4600 Silver Hill Rd	Suitland-Silver Hill	Prince George's	MD	20746	888-758-4389	Public		1	
ELEC	192	CENTRAL GARAGE	7315 Wisconsin Ave	Bethesda	Montgomery	MD	20814	888-758-4389	Public		4	
ELEC	193	CHARLES COUNTY	5205 Ruth B Swann Dr	Indian Head	Charles	MD	20640	888-758-4389	Public	1	1	
ELEC	194	CHARLES COUNTY	12480 Crain Hwy	Newburg	Charles	MD	20664	888-758-4389	Public	1	1	
ELEC	195	CHARLES COUNTY	50 Village St	Waldorf	Charles	MD	20602	888-758-4389	Public	1	1	
ELEC	196	CLINTONELECTRIC	1850 York Rd	Lutherville/Timonium	Baltimore	MD	21093	888-758-4389	Public		2	
ELEC	197	CMT	376-428 Pleasant Hill Rd	Owings Mills	Baltimore	MD	21117	888-758-4389	Public	1	1	
ELEC	198	COLUMBIA ASSOC	6151 Day Long Ln	Clarksville	Howard	MD	21029	888-758-4389	Public	2	2	
ELEC	199	COLUMBIA ASSOC	5460 Old Tucker Row	Columbia	Howard	MD	21044	888-758-4389	Public	1	1	
ELEC	200	COLUMBIA ASSOC	7080 Deepage Dr	Columbia	Howard	MD	21045	888-758-4389	Public	1	1	
ELEC	201	COLUMBIA ASSOC	6800 Cradlerock Way	Columbia	Howard	MD	21045	888-758-4389	Public	1	1	
ELEC	202	DOE GERMANTOWN	19901 Germantown Rd	Germantown	Montgomery	MD	20874	888-758-4389	Public	2	2	
ELEC	203	FASTPARK	1718 W Nursery Rd	Linthicum Heights	Anne Arundel	MD	21090	888-758-4389	Public		8	
ELEC	204	HAMPTON INN	960 N Frederick Ave	Gaithersburg	Montgomery	MD	20879	888-758-4389	Public		2	
ELEC	205	HARBOR PARK	55 Market Pl	Baltimore	Baltimore City	MD	21202	888-758-4389	Public		2	
ELEC	206	HARBOR PARK	55 Market Place	Baltimore	Baltimore City	MD	21202	888-758-4389	Public		2	
ELEC	207	HOWARD COUNTY	3450 Court House Drive	Ellicott City	Howard	MD	21043	888-758-4389	Public		2	
ELEC	208	[illegible]	4371 Parliament Pl	Lanham-Seabrook	Prince George's	MD	20706	888-758-4389	Public	2	2	
ELEC	209	INDIAN HEAD	4195 Indian Head Hwy	Indian Head	Charles	MD	20640	888-758-4389	Public	1	1	
ELEC	210	KOHLS	12024 Cherry Hill Rd	Silver Spring	Montgomery	MD	20904	888-758-4389	Public	1	1	
ELEC	211	LIFEBRIDGE	2401 West Belvedere Ave	Baltimore	Baltimore City	MD	21215	888-758-4389	Public	2	2	
ELEC	212	LIFEBRIDGE	2435-2401 W Belvedere Ave	Baltimore	Baltimore City	MD	21215	888-758-4389	Public	1	1	
ELEC	213	LIFEBRIDGE	3401 Old Court Rd	Randallstown	Baltimore	MD	21133	888-758-4389	Public	1	1	
ELEC	214	LPT	8795 Patuxent Woods Dr	Columbia	Howard	MD	21046	888-758-4389	Public		2	
ELEC	215	MAPLE LAWN II	8155 Maple Lawn Blvd	Fulton	Howard	MD	20759	888-758-4389	Public		8	
ELEC	216	MEDI IMM FACL	200 Orchard Ridge Dr	Gaithersburg	Montgomery	MD	20878	888-758-4389	Public	1	1	1
ELEC	217	MEDI IMM FACL	1 MedImmune Way	Gaithersburg	Montgomery	MD	20878	888-758-4389	Public	1	1	
ELEC	218	MEDI IMM FACL	101 Orchard Ridge Dr	Gaithersburg	Montgomery	MD	20878	888-758-4389	Public	1	1	
ELEC	219	MICA	1401 W Mt Royal Ave	Baltimore	Baltimore City	MD	21217	888-758-4389	Public	2	2	
ELEC	220	MICA	1515 W Mt Royal Ave	Baltimore	Baltimore City	MD	21217	888-758-4389	Public	2	2	
ELEC	221	MOMS ORGANICMKT	9827 Rhode Island Ave	College Park	Prince George's	MD	20740	888-758-4389	Public	2	2	
ELEC	222	MOMS ORGANICMKT	20 W Ridgely Rd	Lutherville/Timonium	Baltimore	MD	21093	888-758-4389	Public	2	2	
ELEC	223	MONTGOMERY PARK	1800 Washington Blvd	Baltimore	Baltimore City	MD	21230	888-758-4389	Public	2	4	
ELEC	224	MTA	5701 Smith Ave	Baltimore	Baltimore City	MD	21209	888-758-4389	Public	1	8	
ELEC	225	MTA	1 Railroad Ave	Baltimore	Baltimore City	MD	21209	888-758-4389	Public	2	2	
ELEC	226	MTA	11 Dorsey Station Dr	Elkridge	Howard	MD	21075	888-758-4389	Public	8	8	
ELEC	227	MTA	Amtrak Way	Linthicum Heights	Anne Arundel	MD	21090	888-758-4389	Public	2	2	
ELEC	228	MTA	8479-8486 Honeygo Blvd	Nottingham	Baltimore	MD	21236	888-758-4389	Public		2	
ELEC	229	MTA	310-332 Lotus Rd	Odenton	Anne Arundel	MD	21113	888-758-4389	Public		2	
ELEC	230	NORTHWEST BMW	9700 Reisterstown Rd	Owings Mills	Baltimore	MD	21117	888-758-4389	Public		2	
ELEC	231	NSA STATION	8800 Savage Rd	Fort Meade	Prince George's	MD	20755	888-758-4389	Public		4	
ELEC	232	NSA STATION	Dennis Rd	Fort Meade	Prince George's	MD	20755	888-758-4389	Public		3	
ELEC	233	OAK CREST	1700 E Northern Pkwy	Baltimore	Baltimore City	MD	21239	888-758-4389	Public		2	
ELEC	234	PASSPORT BMW	5750 Auth Pl	Camp Springs	Prince George's	MD	20746	888-758-4389	Public		2	
ELEC	235	PRIME ST GRILLE	4680 Crain Hwy	White Plains	Charles	MD	20695	888-758-4389	Public	1	1	
ELEC	236	[illegible]	2108 Emmorton Rd	Bel Air	Harford	MD	21015	888-758-4389	Public		1	
ELEC	237	[illegible]	8708 Loch Raven Blvd	Towson	Baltimore	MD	21286	888-758-4389	Public	1	1	
ELEC	238	SILVER SPRING	8211-8235 Automobile Blvd	Silver Spring	Montgomery	MD	20904	888-758-4389	Public		2	
ELEC	239	TOWNEPLACESUITE	5050 Westview Dr	Frederick	Frederick	MD	21703	888-758-4389	Public		2	
ELEC	240	TOWSON	Cross Campus Dr	Towson	Baltimore	MD	21252	888-758-4389	Public	4	4	
ELEC	241	TOWSON	8000 York Rd	Towson	Baltimore	MD	21252	888-758-4389	Public	8	8	
ELEC	242	TOWSON	Towsontown Blvd W	Towson	Baltimore	MD	21204	888-758-4389	Public	4	4	
ELEC	243	TOWSON	Emerson Drive	Towson	Baltimore	MD	21204	888-758-4389	Public	4	4	
ELEC	244	TOWSON	7964-7788 MD-45	Towson	Baltimore	MD	21204	888-758-4389	Public	1	1	
ELEC	245	TRANSPORTATION	110 W Lanvale St	Baltimore	Baltimore City	MD	21217	888-758-4389	Public		1	
ELEC	246	TRANSPORTATION	1201 Rutter St	Baltimore	Baltimore City	MD	21217	888-758-4389	Public		1	
ELEC	247	UDR	3711 Campus	College Park	Prince George's	MD	20740	888-758-4389	Public		2	
ELEC	248	UDR	3711 Campus Dr,	College Park	Prince George's	MD	20740	888-758-4389	Public		2	
ELEC	249	UM FTS	648 W Pratt St	Baltimore	Baltimore City	MD	21201	888-758-4389	Public	2	2	
ELEC	250	UM FTS	500 W Redwood St	Baltimore	Baltimore City	MD	21201	888-758-4389	Public	1	1	

BUIC	151	UM PTS	120 Penn St	Baltimore	Baltimore City	MD	21201	888-758-6580	Public	1	1	
BUIC	152	UM PTS	110 Arch St	Baltimore	Baltimore City	MD	21201	888-758-6580	Public	1	1	
BUIC	153	UM PTS	5 N Paca St	Baltimore	Baltimore City	MD	21201	888-758-6580	Public	2	2	
BUIC	154	UM PTS	622 W Fayette St	Baltimore	Baltimore City	MD	21201	888-758-6580	Public	2	2	
BUIC	155	UM PTS	600 W Lexington St	Baltimore	Baltimore City	MD	21201	888-758-6580	Public	1	1	
BUIC	156	UMD-COLLEGEPARK	4118-4138 Mowatt Ln	College Park	Prince George's	MD	20742	888-758-6580	Public	1	1	
BUIC	157	UMD-COLLEGEPARK	4150-4154 Mowatt Ln	College Park	Prince George's	MD	20742	888-758-6580	Public	1	1	
BUIC	158	UMD-COLLEGEPARK	Library Ln	College Park	Prince George's	MD	20742	888-758-6580	Public	3	3	
BUIC	159	UMD-COLLEGEPARK	Regents Dr	College Park	Prince George's	MD	20742	888-758-6580	Public	3	3	
BUIC	160	UMD-COLLEGEPARK	Paint Branch Dr	College Park	Prince George's	MD	20742	888-758-6580	Public	1	1	
BUIC	161	UMD-COLLEGEPARK	Stadium Dr	College Park	Prince George's	MD	20742	888-758-6580	Public	1	1	
BUIC	162	UMD-SHADY GROVE	9630 Gudelsky Dr	Rockville	Montgomery	MD	20850	888-758-6580	Public		1	
BUIC	163	UMMC	110 S Paca St	Baltimore	Baltimore City	MD	21201	888-758-6580	Public	1	1	
BUIC	164	UNDER ARMOUR	1450 Beason St	Baltimore	Baltimore City	MD	21230	888-758-6580	Public	1	1	
BUIC	165	UNDER ARMOUR	1040 Hull St	Baltimore	Baltimore City	MD	21230	888-758-6580	Public	1	1	
BUIC	166	JBG - Alaire / Higgins Place - Rockville MD	1101 Higgins Place	Rockville	Montgomery	MD	20852	888-868-2144	Public		2	
BUIC	167	JBG - Chase Tower - Chevy Chase MD	4400 Willard Avenue	Chevy Chase	Montgomery	MD	20815	888-868-2144	Public		2	
BUIC	168	JBG - Fishers Lane	5630 Fishers Ln	Rockville	Montgomery	MD	20852	888-868-2144	Public		2	
BUIC	169	JBG Fishers Lane - Rockville MD	5650 Fishers Lane	Rockville	Montgomery	MD	20852	888-868-2144	Public		2	
BUIC	170	King Farm Village Regency	600 Pleasant Drive	Rockville	Montgomery	MD	20850	888-868-2144	Public		1	
UPG	171	U-Haul	4111 W Northern Pkwy	Baltimore	Baltimore City	MD	21215	410-358-1473	Public			
UPG	172	U-Haul	2606 Washington Blvd	Baltimore	Baltimore City	MD	21230	410-644-6024	Public			
UPG	173	Thompson Gas	6708 Old National Pike	Boonsboro	Washington	MD	21713	800-788-6612	Public			
UPG	174	U-Haul	5460 Baltimore National Pike	Catonsville	Baltimore	MD	21228	410-747-6900	Public			
UPG	175	U-Haul	2401 Chillum Rd	Chillum	Prince George's	MD	20782	301-405-1521	Public			
UPG	176	Arundel Gas and Water Conditioning	3177 Solomons Island Rd	Edgewater	Anne Arundel	MD	21037	410-956-2400	Public			
UPG	177	Tri-Gas	3861 Federalsburg Hwy	Federalsburg	Caroline	MD	21632	410-754-2000	Public			
UPG	178	Suburban Propane	208 E Jarrettsville Rd	Forest Hill	Harford	MD	21050	410-838-0018	Public			
UPG	179	Sunbelt	16800 Gaither Ct	Gaithersburg	Montgomery	MD	20878	301-948-6806	Public			
UPG	180	Tri-Gas	15088 Augustine Herman Hwy	Galena	Kent	MD	21658	410-648-5888	Public			
UPG	181	U-Haul	18015 Shawley Dr	Hagerstown	Washington	MD	21740	301-790-1800	Public			
UPG	182	Thompson Gas	17983 Garrett Hwy	Oakland	Anne Arundel	MD	21550	301-387-2400	Public			
UPG	183	Suburban Propane	15644 Old Hanover Rd	Reisterstown	Baltimore	MD	21136	410-833-1400	Public			
UPG	184	Suburban Propane	11 Derwood Cir	Rockville	Montgomery	MD	20850	301-251-0606	Public			
UPG	185	Sharp Energy	520 Commerce St	Salisbury	Wicomico	MD	21804	410-749-6147	Public			
UPG	186	U-Haul	5710 Saint Barnabas Rd	Suitland	Prince George's	MD	20748	301-423-0081	Public			
UPG	187	Suburban Propane	3250 Old Washington Rd	Waldorf	Charles	MD	20602	301-645-7066	Public			

APPENDIX B – Copy of AFV Refueling Station Contact Survey Instrument

Questionnaire

What Type of alternative Fuel does your station have? (Compressed Natural Gas/Electric/ Ethanol/Hydrogen/Liquid Natural Gas/Propane)

Is the station public- or privately-owned?

What is the Address of the Station?

Did you receive grants or other financing to build your Alternative refueling infrastructure? If so, what program?

Did you receive other types of financing mechanisms like loans? If so, what were the general terms (type of institution, loan length, etc.)?

Are there any financing mechanisms that you would have used if available during the purchase of your alternative fueling station? (e.g., low interest loans, lease, energy performance contracting)

What did you perceive as the biggest barrier to establishing the station in Maryland? Permitting, contractors, capital, financing, demographics?

How does the customer pay for the fuel? Circle all that apply. (Credit card/Cash/Prepaid card/ other)

What is the current pump price of your alternative fuels? Can you give an idea of the capital recovery portion of the pump price as %? What about operating and maintenance recovery as %? Can you give me an idea of the average throughput of the station of alternative fuel?

> Monthly or annual gallons or kw-hr (for CNG gasoline gallon equivalent or diesel gallon equivalent)
>
> Average Monthly number of AFVs

How quickly did you need to see a return of investment to justify having your alternative fueling station built?

When building your alternative fueling station, did you ever have the concern that you would not own the station long enough to see the return on your investment? If so, would you have preferred a loan that would be paid back through your property tax, so that if you sold the property the new owner the new owner would be responsible for paying the loans.

It would be very useful for our study if we could get some background information on the cost of your station. This survey is anonymous and will not be shared with any other stations. Could you please provide the following expenses for your alternative fueling station:

APPENDIX C – Summary Listing of Survey Sample Population and Response Results

Fuel Type Code	Station Name/Company Name	contact name	Phone	Email	Relavent to Appendix A station number	Response
CNG	Clean N' Green - Waste Management		800-950-3835		4	NO
CNG	Clean Energy - BWI Airport	Mark Riley	603-410-2256	mriley@cleanenergyfuels.com	1	NO
CNG	Montgomery County Transit	Kalvin Jones	240-777-5730		6,7	YES
CNG	Department of Commerce			inquiries@nist.gov	8	NO
E85	Fredericktowne W Express		301-694-6277		16	NO
E85	Potomac Sunoco		301-299-2090		23	NO
E85	Fox Chapel Sunoco		301-540-6547		20	NO
E85	Takoma Park W Express		301-270-7119		25	NO
E85	Bethesda W Express		301-652-8440		15	NO
E85	Petrolium Marketers Group	David Noland	301-922-7485	dnoland@petromg.com	11-25	NO
E85	Protec Fuel Management	Steve Walk	561-392-3667	steve@protecfuel.com	11-25	NO
E85	Parole Citgo	Wan Kang	410-571-9676	wanskang@gmail.com	12	YES
E85	Mid-Atlantic Petrolium	Peter Troilo	301-972-4116;ext. 101	ptroilo@mappllc.com	11-25	YES
E85	Sustainable Energy Strategies Inc	Jill Hamilton	703-322-4484	jhamilton@sesi-online.com	11-25	YES
E85	Sustainable Energy Strategies Inc	Susan Susanke	703-322-4484	ssusanke@sesi-online.com	11-25	YES
ELEC	The Frederick Motor Company		301-663-6111		163	NO
ELEC	Hamilton Nissan		301-733-7222		184	NO
ELEC	Community College of Baltimore County (CCBC)	Jack Davis	443-840-4509		125	NO
ELEC	Sema Charge	Chrissy Crail	800-663-5633		62-125	NO
ELEC	NRG eVgo	Carly Kade	281-407-1274		147-153	NO
ELEC	Century Ford		888-513-2892		156	NO
ELEC	Frederick Nissan		301-662-0111		33	YES
ELEC	Pohanka Nissan - Salisbury		410-548-4700		50	YES
ELEC	CarMax Nissan - White Marsh		410-931-6500		57	YES
ELEC	Tesla	Alexander Wal	877-798-3752	awalker@teslamotors.com	105185	YES
ELEC	Chargepoint Network	David Nevarez	408-872-7505	david.nevarez@chargepoint.com	158-265	YES
LPG	U-Haul		301-790-1800		281	NO
LPG	Arundel Gas and Water Conditioning		410-956-2400		276	NO
LPG	Suburban Propane		410-838-0015		278	NO
LPG	Sunbelt		301-948-8808		279	NO
LPG	Tri-Gas		410-754-2000		274	NO
LPG	U-Haul		301-403-1521		275	NO
LPG	U-Haul		410-358-1473		271	NO
LPG	Tri-Gas		410-648-5856		280	NO
LPG	Suburban Propane		301-645-7066		287	NO
LPG	Suburban Propane		410-833-1400		283	NO
LPG	Thompson Gas		301-387-2400		282	NO
LPG	Suburban Propane		301-251-0606		284	NO
LPG	Sharp Energy		410-749-4147		285	NO
LPG	U-Haul		410-644-6226		272	NO
LPG	Thompson Gas	Barry Tomas	800-768-6612		273	YES
LPG	U-Haul		410-747-8500		274	YES
LPG	Suburban Propane	Alex Centeno		ACenteno@suburbanpropane.com		YES
LPG	U-Haul		301-423-0055		286	YES
LPG	PERC	Greg Zilberfarb	703-779-4890	greg@tsncommunications.com	271-287	YES
LPG	PERC	Michael Taylor	859-409-1439	michael.taylor@propane.com	271-287	YES

APPENDIX D – Listing of Maryland Financial Barriers to AFV Refueling Infrastructure Implementation

Rank	Category	Financial Barrier	AFV Fuel Type	Bibliography Reference
1	Business case	High Capital Costs for AFV Fueling Infrastructure Installations	ALL	4,7,8,9,11
2	Business case	Lack of Initial AFV Market: Lack of initial AFV market to drive market interest makes it difficult for stations to sell enough fuel to see a timely positive return on investment	ALL	6
3	Business case	E-85 Terminal Piping Limitations: ethanol blends higher than E10 are not available at MD terminals for a reasonable cost due to insufficient terminal piping. MD fuel marketers pay a premium for trucking E85 from out of state terminals and would have to pay a larger premium to obtain E85 from in-state terminals due to the terminal piping limitations.	E-85	4,7, 10
4	Financial Product Limitations	Financial Product Scale: The transaction costs associated with loan origination, attorney fees, monitoring, and servicing financial products are higher per product when only a few financial products are transacted. More transactions that use the same processes, templates and formulations reduce the per product cost. This applies to AFV refueling infrastructure loans in which there is very little experience base and limited standardized loan models to follow, creating higher loan-related costs.	ALL	1
5	Financial Product Limitations	Legal and Regulatory Hurdles: Rules about the kinds of financial instruments investors can hold, and restrictions on contract types and terms can both limit investment in AFVs and their infrastructure. This is especially true for government agencies, laws governing public procurement and the structure of competitive solicitations for goods and services can make some contracts, even ones that would save public agencies money, explicitly illegal.	ALL	1
6	Financial Product Limitations	Liquidity Risk: New technologies and new financial products initially face a market uncertain of their benefits and costs. Also, they are often considered more risky as well as harder to buy and sell; in other words, the implementation of these new technologies are challenged by "liquidity" concerns. Rules around the liquidity of financial products and investments require banks to hold safe capital in reserve when they own assets that are harder to sell.	ALL	1
7	Business case	Public Entities Unable to Use Incentives: Public incentives, like tax credits and grants, exist to facilitate the deployment of AFV fueling infrastructure, but face eligibility issues similar to AFV tax incentives. For instance, tax credits for EV charging stations are often provided, but public entities cannot use it because they do not pay taxes.	ALL	1
8	Infrastructure Restrictions	CNG Utility Availability: The costs charged by utilities for providing natural gas pipeline service can be prohibitive if the locality or region is not already served by adequate pipeline infrastructure and/or capacity.	CNG	8
9	Infrastructure Restrictions	Electric Utility Capacity: Local/regional electric utility capacity for serving local/regional EV charging stations, especially clustered stations, can be a limiting factor for installation chargers. The costs for increasing local/regional electrical capacity can be passed onto station owners through higher rates or subsidies.	EV	3,5
10	Infrastructure Restrictions	CNG Utility Rate Structure: There is often natural gas utility rate structure uncertainty/variability for CNG refueling which can be a turnoff for potential station owner developers.	CNG	
11	Infrastructure Restrictions	Electrical Demand Charges: Demand charges by electric utilities are high for fast charging and clusters of smaller level 2 charger, especially in less populated areas	EV	3
12	Business case	Renewable Fuels Standard Uncertainty: EPA will not issue a final renewable fuel standard for 2014 by the end of calendar year 2014. Instead EPA will issue a new rule in 2015 to set standards for 2014-2016. This rule is nearly a year overdue. This creates uncertainty regarding the volume of biofuels that marketers will be required to sell each year, affecting the entire supply chain. If there is too much production capacity/supply for the demand then the costs will decrease and producers will take a financial hit. If there is not enough production/supply for the demand then costs will increase and it may make selling E85 more difficult.	E-85	4
13	Education and Outreach	Need for Education/Outreach for E85: Most Flex fuel vehicle owners are not aware that their vehicles can run on E85. Current estimates place the number of FFVs in the State around 25,000, but very few actually use E85, thereby limiting station throughput and profitability. The costs for education/outreach/marketing are prohibitive, especially under the low station throughput condition.	E-85	4
14	Business case	Higher Insurance Premiums: owners of AFV stations could be penalized with higher premiums due to perceived risk with AFV refueling systems.	ALL	5
15	Business case	Private Fleet Fueling Preference: Because AFVs are mostly used in fleet applications, AFV infrastructure providers tend to focus on onsite fueling for fleets rather than stations open to the general public. This results in less station utilization at public AFV stations and thus less profitability.	CNG, LPG,E85	1
16	Business case	Lack of Industry/Government Partnerships: partnerships create opportunities for developing funding, amortizing costs, and developing critical mass for station utilization. Without partnerships, organizations face higher costs for marketing and covering capital and operational costs.	ALL	6
17	Education and Outreach	Local/Regional Contractor Limitations: Lack of licensed/qualified contractors for local/regional competitive pricing in installing AFVs can result in higher installation costs.	ALL	2, 4, 10
18	Education and Outreach	Information Failures: Lack of credible, reliable information about new technology, including batteries (cost, life and recharging), and future market demand for AFVs and fueling infrastructure limit interest in private sector financial solutions.	ALL	1
19	Infrastructure Restrictions	CNG Equipment Electrical Capacity: If a site does not have adequate electrical capacity for CNG fuelling equipment, an electrical upgrade may be necessary.	CNG	8